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Toyoshi KAWADA et al.

Application No.: 09/468,639 Group Art Unit: 2629

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For: PLASMA DISPLAY PANEL DEVICE

SUBMISSION OF VERIFIED ENGLISH TRANSLATION OF PRIOR FOREIGN APPLICATION UNDER 37 C.F.R. § 1.55

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sir:

According to 37 C.F.R. § 1.55, to perfect the Applicants' foreign priority date, a verified English translation of the following certified foreign priority application of the above-identified U.S. patent application is submitted:

Japanese Patent Application No:.10-374269

Filed: December 28, 1998

A Declaration regarding the verification of the English translation is submitted concurrently.

It is respectfully requested that the Applicants be given the benefit of the foreign filing date as evidenced by the certified foreign priority application submitted and the verified English translation thereof submitted herewith, in accordance with the requirements of 35 U.S.C. § 119.

Respectfully submitted,

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CERTIFICATE OF VERIFICATION

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do hereby declare that I am familiar with the English and Japanese languages, that I am the translator of Japanese Patent Application No. 10-374269 that the said translation is correct to the best of my knowledge and ability.

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[Name of Document] Description
[Title of the invention] PLASMA DISPLAY PANEL DEVICE

[Claims]

[Claim 1] A plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes, said plasma display panel device comprising:
a drive circuit that connects said first and second electrodes to power sources that are different from said ground power source so as to apply a discharge voltage between the two electrodes, when discharge voltage pulses are to be applied between said first and second electrodes.

[Claim 2] A plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes, said plasma display panel device comprising:
a drive circuit that connects said first and second electrodes to a power source that is different from said ground power source so as to apply a specific discharge voltage between the two electrodes, upon completion of the application of discharge voltage pulses after said discharge voltage pulses have been applied between said first and second electrodes.

[Claim 3] A plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes, said plasma display panel device comprising:
a drive circuit that changes said first and second electrodes from a state of being connected to a first power source different from said ground power source to a state of being connected to a second power source different from said ground power source so as to apply a specific discharge

voltage between the two electrodes, when discharge voltage pulses are to be applied between said first and second electrodes.

[Claim 4] The plasma display panel device according to Claim 3, wherein:

said drive circuit returns said first or second electrode to a state of being connected to said first power source upon completion of the application of said discharge voltage pulse.

[Claim 5] A plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes, said plasma display panel device comprising:

a drive circuit that changes said first and second electrodes from a state of being connected to a first power source different from said ground power source to a state of being respectively connected to second and third power sources different from said ground power source so as to apply a specific discharge voltage between the two electrodes, when discharge voltage pulses are to be applied between said first and second electrodes.

[Claim 6] The plasma display panel device according to Claim 5, wherein:

said drive circuit returns said first and second electrodes to a state of being connected to said first power source upon completion of the application of said discharge voltage pulse.

[Claim 7] A plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes, said plasma display panel device comprising:

a drive circuit that changes said first and second

electrodes from a state of being connected to first and second power sources different from said ground power source to a state of being connected to a third power source different from said ground power source so as to apply a specific discharge voltage between the two electrodes, when discharge voltage pulses are to be applied between said first and second electrodes.

[Claim 8] The plasma display panel device according to Claim 7, wherein:

said drive circuit returns said first or second electrode to a state of being connected to said first or second power source upon completion of the application of said discharge voltage pulse.

[Claim 9] A plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes, said plasma display panel device comprising:

a drive circuit that changes said first and second electrodes from a state of being connected to first and second power sources different from said ground power source to a state of being respectively connected to third and fourth power sources different from said ground power source so as to apply a specific discharge voltage between the two electrodes, when discharge voltage pulses are to be applied between said first and second electrodes.

[Claim 10] The plasma display panel device according to Claim 9, wherein:

said drive circuit returns said first and second electrodes to a state of being respectively connected to said first and second power sources upon completion of the application of said discharge voltage pulse.

[Claim 11] The plasma display panel device according to any of Claims 5 to 10, wherein:

reversed-polarity discharge voltage pulses are applied to said first and second electrodes.

[Claim 12] The plasma display panel device according to any of Claims 1 to 10, further having a control portion that is connected to said ground power source and that supplies a control signal to said drive circuit.

[Claim 13] The plasma display panel device according to any of Claims 1 to 10, wherein:
said first and second electrodes are a pair of electrodes provided in parallel along the display line.

[Claim 14] The plasma display panel device according to Claims 13, wherein:
said discharge voltage pulses are applied during a full-write period or a sustaining discharge period.

[Claim 15] The plasma display panel device according to Claim 3 or 4, wherein:
the potential of said ground is between the potential of said first power source and the potential of the second power source, and a third electrode is maintained at the potential of the ground power source during the application of said discharge voltage pulse.

[Claim 16] The plasma display panel device according to Claim 5 or 6, wherein:
the potential of said ground is between the potential of said first power source and the potential of the second power source, or is between the potential of said first power source and the potential of the third power source, and a third electrode is maintained at the potential of the ground power source during the application of said discharge voltage pulse.

[Claim 17] A plasma display panel device that performs display by discharge between first and second electrodes

provided in parallel along the display line, said plasma display panel device comprising:

a control circuit, connected to a ground power source, for generating a control signal; and

a drive circuit that drives said first and second electrodes in response to said control signal,

wherein, when discharge voltage pulses are to be applied to said first or second electrode, said drive circuit supplies the start voltage of said discharge voltage pulses from a first power source that is different from said ground power source to said first or second electrode, and supplies the end voltage of said discharge voltage pulses from a second power source that is different from said ground power source.

[Claim 18] A plasma display panel device according to Claim 17, further comprising: an address electrode provided intersecting with said first and second electrodes,

wherein the address electrode is maintained at the ground potential between the potentials of said first and second electrodes when said discharge voltage pulses are to be applied to the first and second electrodes.

[Claim 19] A method for driving a plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes,

wherein said first and second electrodes are connected to a power source that is different from said ground power source and a specific discharge voltage is applied between said electrodes when discharge voltage pulses are to be applied between said first and second electrodes.

[Claim 20] A method of driving a plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes,

wherein said first and second electrodes are connected to a power source that is different from said ground power source and a specific discharge voltage is applied between said electrodes upon completion of the application of discharge voltage pulses after said discharge voltage pulses have been applied between said first and second electrodes.

[Claim 21] A method of driving a plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between said first and second electrodes,
wherein said first and second electrodes are changed from a state of being connected to a first power source different from said ground power source to a state in which the first or second electrode is connected to a second power source different from said ground power source, and a specific discharge voltage is applied between said electrodes when discharge voltage pulses are to be applied between said first and second electrodes.

[Details of the invention]
[0001]
[Field of the Invention] The present invention relates to a plasma display panel device that performs display by utilizing plasma discharge to emit light, and to a method for driving this device, and more particularly relates to a plasma display panel device in which malfunctions are reduced by decreasing the power source noise caused by generation of the discharge current, and to a method for driving this device.

[0002]
[Prior Art]
Plasma display panel devices (hereinafter referred to as PDP devices) are attracting notice as flat displays that have a large screen and a wide viewing angle. In particular, the three-electrode type of surface discharge AC drive PDP

devices which have been developed recently allow full-color displays, and are expected to be very popular in television sets, computer display devices, and so forth.

[0003]

A PDP device generates a discharge between a pair of electrodes by application of a discharge voltage between the electrodes, and the desired display is achieved through the generation of light from a fluorescent material that accompanies this discharge. In order to apply this discharge voltage, discharge voltage pulses are applied to at least one of the electrodes. The application of discharge voltage pulses is accompanied by the application of a high voltage between the electrodes, which generates a discharge, and excess discharge current flows from one of the electrodes toward the other electrode during the generation of this discharge.

[0004]

Figure 24 is a diagram illustrating the drive waveform of a conventional three-electrode surface discharge AC-PDP device. Figure 24(a) illustrates a first example, and Figure 24(b) a second example. A three-electrode surface discharge AC-PDP device has an address electrode A on one substrate, and has on another substrate an X electrode and a Y electrode disposed perpendicular to the address electrode. The drive method is as shown in simplified fashion in the figure, and comprises a reset period RST in which full writing W and full erasure E are performed, an address period ADD in which discharge is performed selectively according to the display data, and a sustaining discharge period SUS in which sustaining discharge is performed for an illuminated cell in the address period.

[0005]

In both examples, the reference potential of the various electrodes is the ground potential, and when voltage pulses are applied, the specified voltage is applied from

the ground potential, and the potential returns to its original ground level after a specific period of time. In the reset period, the Y electrodes are kept at the ground potential while high-voltage write pulses WP are applied to all of the X electrodes. The application of these write pulses WP causes all of the cells to light up and enter more or less the same state. After this, the X electrodes are kept at the ground potential while erase pulses EP are applied to all of the Y electrodes, so that all of the cells are lighted and then erased. As a result, no wall charges are stored in any of the cells.

[0006]

In the subsequent address period ADD, negative scan pulses SCP are successively applied to the Y electrodes, and address pulses ADP are selectively applied to the address electrodes according to the display data in synchronization with the above-mentioned SCP application. As a result, the combined voltage of the two pulses SCP and ADP is applied between the address electrodes and the Y electrodes, generating an address discharge. Wall charges are stored in the lighted cells as a result of this. Then, in the sustaining discharge period, sustaining discharge pulses SUSP are applied alternately to the X electrodes and Y electrodes, which generates sustaining discharges a plurality of times for the above-mentioned cells in which walls charges are stored. The brightness of the cells is controlled by the number of these sustaining discharges. In example 1 in Figure 24(a), the sustaining pulses SUSP are positive voltage pulses, whereas in example 2 in Figure 24(b), the sustaining pulses SUSP are negative voltage pulses.

[0007]

[Problems to be solved by the Invention]

As mentioned above, in the sustaining discharge period, sustaining voltage pulses SUSP are alternately applied between the X electrodes and Y electrodes serving as the

display electrodes. With a conventional drive method, the application of the sustaining voltage pulses SUSP maintains the X electrodes or Y electrodes at the ground potential, which is the reference potential, the potential is driven from this ground potential to the sustaining discharge voltage, that is, to the level of a positive voltage +Vs or the level of a negative voltage -Vs, and upon completion of the pulse period, the potential is returned to the ground potential level. When this sustaining discharge voltage is applied, excess discharge current flows between the X and Y electrodes, and the path thereof is a loop going from the sustaining discharge voltage power source of voltage +Vs or -Vs, to a switch circuit on the source side, one of the electrodes, a discharge space, the other electrode, a switch circuit on the sink side, and then the ground power source, and finally returning to the ground terminal of the sustaining discharge voltage power source.

[0008]

This sustaining voltage pulses Vs are high-voltage, high-speed pulses with a voltage of approximately 200 V and a rise time of just a few hundred nanoseconds, and a peaked discharge current instantly flows as soon as the pulses are applied. Such a peak current is called a panel capacitance charging and discharging current, or a gas discharge current. When this large peaked current flows to the ground power source line, the voltage thereof is lowered by the impedance component had by the ground power source line, and a noise component, namely, a fluctuation in the ground potential, is generated. This noise component of the ground potential can become admixed in surrounding control circuits, disrupt the waveform of the control signals, and lead to malfunction. Or, even if a malfunction does not occur, distortion can occur not only in the control signals but also in the drive waveform itself, leading to the generation of a high-frequency component. The generation of a high-frequency component is a cause of electromagnetic wave noise being radiated to the surrounding area, and is also a cause of

interference with external electrical devices.

[0009]

These problems similarly occur in the application of write pulses between the X electrodes and Y electrodes in the reset period. Gas discharge current is generated during rise when the write pulses WP are applied, and a charging and discharging current is generated during fall at the completion of the application of the write pulses WP.

[0010]

A separate problem is that when sustaining pulses SUSP of positive polarity are applied to the X and Y electrodes, if the address electrode A is maintained at the ground potential, then the address electrode side will have negative polarity, and a positive charge will be stored on the surface of the address electrode. This stored charge has a polarity that is added to the address voltage during the address period, so an excessively large address discharge is generated, which can lead to excess discharge to adjacent cells. This excess discharge is a cause of variance. Furthermore, if the address electrode side has an extremely negative voltage with respect to the X and Y electrodes, positive charges may collide with the fluorescent material provided on the address electrode, shortening the service life of the fluorescent material.

[0011]

To solve such problems, as shown in Figure 24(a), it has been proposed that an intermediate voltage of Va be applied to the address electrode during the sustaining discharge period. In this case, however, if spiked noise is superimposed on the output side of the drive circuit of the address electrode as a result of capacity coupling or the like accompanying the application of the sustaining pulses, then the potential thereof will be at a level that is higher than the power source voltage level, there will be no margin with respect to the withstand voltage of the drive circuit,

and adequate reliability cannot be ensured.

[0012]

In view of this, it is an object of the present invention to provide a plasma display panel device in which noise is prevented from being generated at the ground power source when sustaining pulses, write pulses, or other such discharge voltage pulses are applied, as well as a method for driving this device.

[0013] Another object of the present invention is to provide a plasma display panel device in which positive charges are prevented from being stored on the address electrode side when sustaining pulses, write pulses, or other such discharge voltage pulses are applied, as well as a method for driving this device.

[0014] Another object of the present invention is to provide a plasma display panel device in which the collision of positive charges on the address electrode side is controlled when sustaining pulses, write pulses, or other such discharge voltage pulses are applied, as well as a method for driving this device.

[0015]

[Means of solving the problems]

To achieve at least one of the stated object, the present invention, discharge voltage pulses are applied between a pair of electrodes by driving a first power source having a specific voltage from a state in which the electrodes are maintained at the potential of a reference power source that is different from the potential of the ground power source, and then returning it to the reference power source. As a result, the gas discharge current or capacitance charging and discharging current accompanying the application of the discharge voltage pulses is prevented from flowing to the first power source line. The above-mentioned gas discharge current or capacitance charging and

discharging current resulting from the application of the discharge voltage pulses flows to the first power source or the reference power source electrically separated from the ground power source, and does not flow to the ground power source line, so no noise is generated on the first power source.

[0016] Furthermore, the present invention is such that when discharge voltage pulses are to be applied between a pair of electrodes, the electrodes are driven such that they are connected to a first power source having a specific voltage from a state in which they are maintained at the potential of a reference power source that is different from the potential of the ground power source, and are then returned to the potential of the reference power source. In this case, the reference the reference power source and the first power source are selected so that the ground potential will be between the potential of the reference power source and that of the first power source. Then, by keeping third electrode at the ground potential when the discharge voltage pulses are to be applied, the voltage thereof can be kept against the pair of electrodes, and the storage of wall charges in the third electrodes and the collision of positive ions can be suppressed.

To achieve at least one of the stated object, the present invention is a plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between the first and second electrodes, this device comprising: a drive circuit that connects the first and second electrodes to power sources that are different from the ground power source so as to apply a discharge voltage between the two electrodes when discharge voltage pulses are to be applied between the first and second electrodes.

[0017] With the above-mentioned invention, when discharge voltage pulses are to be applied, discharge current is

supplied and absorbed from a power source that is different from the ground power source, so no noise generated at the ground power source line, and malfunction or disruption of the drive waveform can be prevented.

[0018] Further, to achieve the stated object, the present invention is a plasma display panel device having first and second electrodes provided apart from one another and a ground power source, and performing display by generating a discharge between the first and second electrodes, this device comprising: a drive circuit that connects the first and second electrodes to a power source that is different from the ground power source so as to apply a specific discharge voltage between the two electrodes, upon completion of the application of discharge voltage pulses after the discharge voltage pulses have been applied between the first and second electrodes.

[0019] Similarly, the above invention is also such that when discharge voltage pulses are to be applied, discharge current is supplied and absorbed from a power source that is different from the ground power source, so no noise is generated at the ground power source line, and malfunction or disruption of the drive waveform can be prevented.

Further, to achieve at least one of the stated object, the present invention is a plasma display panel device that performs display by discharge between first and second electrodes provided in parallel along the display line, the device comprising: a control circuit, connected to a ground power source, for generating a control signal: and a drive circuit that drives said first and second electrodes in response to said control signal, wherein, when discharge voltage pulses are to be applied to said first or second electrode, the drive circuit supplies the start voltage of the discharge voltage pulses from a first power source that is different from the ground power source to the first or second electrode, and supplies the end voltage of the discharge voltage pulses from a second power source that is

different from the ground power source.

[0020] Furthermore, a preferred embodiment of the present invention, further having an address electrode provided intersecting with the first and second electrodes, and maintaining the address electrode at the ground potential between the potentials of the first and second power source when the discharge voltage pulses are to be applied to the first and second electrodes.

[0021] With the embodiment, the potential differential can be reduced between the address electrode and the first and second embodiment, and the amount of wall charges stored in the address electrode can be reduced. Also, the collisions of positive ions into the fluorescent material on the address electrode can be reduced, allowing the service life of the fluorescent material to be extended.

[0022]

[DESCRIPTION OF THE PREFERRED EMBODIMENTS]

Embodiments of the present invention will now be described through reference to the figures. These embodiments do not, however, limit the technological scope of the present invention. A three-electrode surface discharge AC-type PDP device will be used as an example in the following description of the embodiments, but the present invention can be applied to PDP devices with a variety of structures.

[0023]

Figure 1 is a plan view of a three-electrode surface discharge AC type of PDP device in an embodiment. The PDP shown in Figure 1 is provided with a plurality of address electrodes 12 arranged perpendicular to a back glass substrate 10. Ribs 20 are provided between the address electrodes 12, and X electrodes 16 and Y electrodes 18 are provided to a front glass substrate 14 such that they are alternately laid out horizontally. The X electrodes 16 are usually such that a plurality of electrodes are connected in

common and driven by a common X driver, which is discussed below. The Y electrodes function as scanning electrodes to which scanning pulses are successively applied during the address period, and also function as display electrodes or sustaining electrodes to which sustaining discharge pulses are applied in common during the sustaining discharge period.

[0024]

Figure 2 is a cross section of the PDP in Figure 1. Figure 2 shows the cross sectional structure along the X electrodes or Y electrodes. The address electrodes 12 are provided on the back glass substrate 10, over which are provided a dielectric layer 22 and partitions (ribs) 20. A fluorescent material 24 is provided over the dielectric layer 22 and between the ribs 20. The front glass substrate 14 is provided with a discharge space between it and the back glass substrate 10. The X electrodes 16 and Y electrodes 18 are provided over the front glass substrate 14, and over these are provided another dielectric layer 22. As shown in Figure 2, an opposing electrode capacitance Cg is parasitically formed between the address electrodes 12 and the Y electrodes 18, and an adjacent electrode capacitance Ca is parasitically formed between the X electrodes 16 and the Y electrodes 18 as well.

[0025]

Figure 3 is a block diagram of the drive circuit in the PDP in Figures 1 and 2. The address electrodes provided to the panel 1 are driven by an address driver 23, the X electrodes are driven by a common X electrode driver 25, and the Y electrodes are driven by a scanning driver 26 during the address period, and by a common Y electrode driver 28 during the sustaining discharge period. Each driver is supplied with control signals from a control circuit 30 so as to control the drive operations thereof. The control circuit 30 utilizes a ground power source GND for a reference voltage to produce the various control signals.

[0026]

The control circuit 30 has a display data control portion 32, a scanning driver control portion 34, a common driver control portion 36, and so on, and is supplied with clock pulses CLK, display data DATA, vertical synchronization signals Vsync, horizontal synchronization signals Hsync, and so on from a computer, a tuner, or the like. The display data control portion 32 receives the display data DATA and performs the required A/D conversion, intensity level adjustment, data conversion, and so forth, and supplies data signals for display to the address driver 22. The scanning driver control portion 34 supplies scanning control signals to the scanning driver 26 in synchronization with the synchronization signals. The common driver control portion 36 produces control signals for the application of write pulses or erase pulses during the reset period and for the application of sustaining pulses during the sustaining discharge period, and supplies these control signals to the drivers 24 and 28.

[0027]

Figure 4 is a diagram illustrating the first drive method in this embodiment. This is an example of sustaining pulses applied between the X electrodes and Y electrodes. Figure 4(a) illustrates the drive waveforms of the address electrodes A and the X and Y electrodes, and Figure 4(b) illustrates the path of the discharge current and the drive circuit of the X and Y electrodes. With the first drive method in Figure 4, the X and Y electrodes are both maintained at a negative first power source potential -V1 that is different from the ground power source GND, and are alternately driven to a positive second power source potential +V2 and then returned to the first power source potential -V1. To this end, power sources V2 and V1, which use the ground power source GND as a reference, are provided in the drive circuit, and the first power source potential -V1 and second power source +V2 constitute a power source line that is electrically separate from the ground power

source line GND.

[0028]

The drive circuit of the X electrodes comprises of N channel transistors Q5 and Q6, and these transistors are supplied with control signals from the common driver control portion 36. The X electrodes are connected to the first power source -V1 via the transistor Q6, and to the second power source +V2 via the transistor Q5. The drive circuit of the Y electrodes is provided with a P channel transistor Q1, an N channel transistor Q2, and diodes D1 and D2 for each Y electrode as a scanning driver circuit, and is provided with N channel transistors Q3 and Q4 as a common Y driver. These transistors Q1 and Q2 and diodes D1 and D2 are similarly connected for all of the Y electrodes. The transistors Q1 and Q2 are supplied with scanning scan pulses SCPs from the scanning driver control portion 34, and perform an operation whereby scanning pulses are applied to each Y electrode. The transistors Q3 and Q4 are supplied with control signals from the common driver control portion 36, and during sustaining discharge there is a connection to the first power source -V1 via the diode D1 and the transistor Q3, and a connection to the second power source +V2 via the diode D2 and the transistor Q4.

[0029]

As shown in Figure 4(a), during the period t1 the transistors Q3 and Q6 are conductive and the X and Y electrodes are maintained at the potential of the first power source -V1 in order to perform sustaining discharge. (More accurately, the Y electrodes are maintained at a higher potential than the first power source -V1 by an amount equal to the forward voltage of the diode D1.) The transistor Q3 is then turned off and the transistor Q4 turned on, which connects the Y electrodes to the second power source +V2 and applies a discharge pulse. After the pulse period, the transistor Q4 is turned off and the transistor Q3 turned on, and the Y electrodes are once again

connected to the first power source -V1.

[0030]

Therefore, when discharge pulses have been applied to the Y electrodes in the period t1, the discharge current flows along the path shown in Figure 4(b), comprising the second power source +V2, the transistor Q4, the diode D2, the Y electrodes, the discharge cells, the X electrodes, the transistor Q6, and the first power source -V1. Therefore, an excessively large discharge current does not flow to the ground power source line GND.

[0031]

Furthermore, current flows between the electrodes via the first power source -V1 during the fall of the pulses upon completion of the application of the discharge pulses. Here again, no current flows to the ground power source line GND.

[0032]

In period t2, this time the discharge pulses are applied on the X electrode side, in which case the discharge current flows along the path opposite to the path shown in Figure 4(b), comprising the second power source +V2, the transistor Q5, the X electrodes, the discharge cells, the Y electrodes, the diode D1, the transistor Q3, and the first power source -V1. Here again, no excessively large current flows to the ground power source GND.

[0033]

Therefore, no noise is generated by a large current at the ground power source GND, no malfunction occurs in the control circuit 30 which utilizes the ground power source as a reference power source, and there is no disruption of the control signals generated by control circuit.

[0034]

Furthermore, the address electrodes are maintained at

the ground potential when the sustaining pulses are applied. The sustaining pulses are applied by raising the potential of the X and Y electrodes from the potential of the first power source -V1, which is lower than the ground potential, to the potential of the second power source +V2, which is higher than the ground potential, and then returning this potential to that of the first power source -V1. Therefore, only a voltage that is more or less intermediate is applied as the voltage of the sustaining pulses between the address electrodes maintained at the ground potential and the X and Y electrodes. Accordingly, during the application of sustaining pulses, it is possible to prevent the potential of the address electrodes from being too low and excessive positive charges from being stored or colliding forcefully.

[0035]

Figure 5 is a diagram illustrating the second drive method in this embodiment. The drive circuit in Figure 5(b) has the same structure as that in Figure 4(b). Figure 5 is an example of applying sustaining pulses of reverse polarity of Figure 4. Specifically, as shown by the drive waveforms in Figure 5(a), the X and Y electrodes are connected to the positive power source +V2, which is higher in potential than the ground potential GND, is driven to the potential of the negative power source -V1, which is lower than the ground potential, and is then returned to the potential of the positive power source +V2. Therefore, in the period t1, when a negative discharge pulse has been applied to the Y electrodes, the discharge current flows along the path shown in Figure 5(b), comprising the positive power source +V2, transistor Q5, the X electrodes, the discharge cells, the Y electrodes, the diode D1, the transistor Q3, and the negative power source -V1. Specifically, no discharge current flows to the ground power source line GND, nor is any noise generated. In the period t2, negative discharge pulses are applied on the X electrode side, so the discharge current flows along the path shown in Figure 4(b), and no discharge current goes into the ground power source GND.

[0036]

Again in the case of Figure 5, when discharge pulses have been applied, the address electrodes are maintained at the ground potential, so a large electric field is not applied between the address electrodes and the X and Y electrodes, and negative charges are prevented from colliding or being stored on the address electrode side. In particular, the potential of the address electrodes is lower than that of the X and Y electrodes, so positive charges are prevented from colliding with the fluorescent layer.

[0037]

Figure 6 is a diagram illustrating the third drive method in this embodiment. In this example, discharge pulses of reverse polarity are simultaneously applied to the X electrodes and Y electrodes, and applying this combined voltage between the X and Y electrodes generates a discharge. In this case, the X and Y electrodes are both driven to the potential of the power sources -V3, +V2, and -V1 separate from that of the ground power source GND, so no discharge current flows to the ground power source GND.

[0038]

As shown by the drive waveforms in Figure 6(a), the X and Y electrodes are initially maintained at the potential of the negative power source -V3. In period t1, the Y electrodes are driven to the potential of the positive power source +V2, and at the same time, the X electrodes are driven to the potential of the negative power source -V1. The combination of these two discharge pulses results in the application of the discharge pulses shown in Figures 4 and 5 between the X and Y electrodes. Upon completion of the pulse application, the X and Y electrodes are returned to the potential of the power source -V3. In period t2, discharge pulses with polarity reversed from that given above are applied to the electrodes from the negative power source -V3, which applies a voltage between the electrodes

in the opposite direction from that in period t1 and generates a discharge. Here again, the electrodes absorb discharge current supplied from a power source having a different potential from that of the ground potential, so no noise is generated at the ground power source.

[0039]

The drive circuit is shown in Figure 6(b). In order to perform the third drive method, the power source -V3 is added to this drive circuit in addition to the drive circuits of Figure 4B and Figure 5B, and transistors Q7, Q8, Q9, and Q10 are also added. These transistors constitute the common electrode drivers 24 and 28 of the respective electrodes, and are supplied with control signals from the corresponding common driver control portion 36.

[0040]

With this drive circuit, in period t1, first the transistors Q9, Q10, Q7, and Q8 are conductive to maintain the X and Y electrodes at the potential of the power source -V3. The transistor Q6 is then conductive to connect the X electrodes to the power source -V1, and the transistor Q4 is conductive to connect the Y electrodes to the power source +V2 via the transistor Q4 and the diode D2. As a result, as shown in the figure, the discharge current flows through a path comprising the power source +V2, the transistor Q4, the diode D2, the Y electrodes, the discharge cells, the X electrodes, the transistor Q6, and the power source -V1. Next, the transistors Q9, Q10, Q7, and Q8 are conductive to return the X and Y electrodes to the potential of the power source -V3. At this point, the parasitic capacity between the two electrodes is short-circuited, but this short-circuit current also only flows to the power source -V3. As above, in period t1, even if discharge pulses of reserve polarity are applied to the two electrodes, this will not be accompanied by the generation of noise at the ground power source.

[0041]

In period t2, the operation is just carried out in completely the opposite polarity as above, and no discharge current or short-circuit current goes into the ground power source, and no noise is generated.

[0042]

With the third method discussed above, voltage changes in the rise and fall of the discharge pulses applied to the X and Y electrodes can be kept smaller than in the first and second methods. As a result, the drive of the various electrodes is easier, and the generation of higher harmonics that accompanies this drive can be reduced.

[0043]

Figure 7 is a diagram illustrating the fourth drive method in this embodiment. Again in this example, just as in the third drive method, discharge pulses of reverse polarity are applied simultaneously to the X electrodes and Y electrodes, and a discharge is generated by applying the combined voltage thereof between the X and Y electrodes. With the fourth drive method, however, both electrodes are maintained at a state of being at the reference potential of the positive power source +V3, then the Y electrodes are driven to the potential of the positive power source +V2, which is higher than the potential of the positive power source +V3, and the X electrodes are driven to the potential of the negative power source -V1 and then both returned to the reference potential +V3. As a result, discharge pulses of reverse polarity are applied to both electrodes, and their combined voltage is applied between the two electrodes.

[0044]

The drive circuit in Figure 7(b) is basically the same as that in Figure 6B. In the state in which discharge pulses have been applied in period t1, the discharge current flows through the path shown in the figure, comprising the power source +V2, transistor Q5, the X electrodes, the

discharge cells, the Y electrodes, the diode D1, the transistor Q3, and the power source -V1. Accordingly, no discharge current flows to the ground power source GND, and no noise is generated. Even after the completion of the discharge pulses, since the two electrodes are not connected to the ground power source GND, no short-circuit current flows the ground power source.

[0045]

Again in the third and fourth drive methods, since the address electrodes are kept at the ground potential, the potential between the address electrodes and the X electrodes and Y electrodes is smaller, making it possible to minimize the problems of wall charge storage on the address electrodes and the collision of positive charges.

Specific embodiments of the drive of a PDP utilizing the four types of drive method given above will now be described.

[0046]

[First Embodiment]

Figure 8 is a diagram illustrating the drive waveform in the first embodiment, while Figure 9 is a diagram illustrating the drive circuit in the first embodiment. This embodiment illustrates the constitution of the drive waveforms and drive circuit applied to a three-electrode type of surface discharge AC-PDP. As shown by the drive waveforms in Figure 8, the drive waveforms of the X and Y electrodes in the sustaining discharge period SUS and the drive waveforms of the two electrodes in the full-write period W are similar to the drive waveforms in the first drive method discussed above. The drive circuit utilizes the transistors Q1 and Q2 in the scanning drive of the Y electrodes in the address period, at which time the diodes D1 and D2 are both reverse biased. The rest of the transistors are controlled by the common drive control portion in the full-write and sustaining discharge periods.

[0047]

In this embodiment, the method for applying sustaining voltage pulses to the display electrodes of the Y electrodes and X electrodes, which are laid out in parallel on the front side, is to form sustaining voltage pulses SUSP between the two power source voltages of the power sources -Vs1 and +Vs2, and apply these to the Y and X electrodes. After the address period ADD is finished, the voltage levels for the Y electrodes, the X electrodes, and the address electrodes are first set to the ground potential GND by transistors Q41 and Q42, after which the sustaining period SUS is commenced. Along with the start of the sustaining period SUS, the voltage levels of both the Y electrodes and the X electrodes are dropped to the power source -Vs1 level, this is set as the reference voltage, and the voltage level of the address electrodes is maintained as the state of the ground potential GND. Between the Y and X sustaining electrodes, sustaining voltage pulses SUSP of the level of the power source +Vs2 are applied first to the Y electrodes from the reference voltage of the power source -Vs1, which generates a sustaining discharge between the X electrodes and Y electrodes and generates discharge illumination, and at the same time, a peaked gas discharge current flows. The discharge current here has been raised to a high potential level on the Y electrode side, so it flows from the supply power source of the power source +Vs2 to the power source -Vs1, going through a switching element Q4 on the Y electrode side, the Y electrodes, the discharge cells, and the X electrodes, and then through a switching element Q6 on the X electrode side. At this point, the ground terminal side GND of the two power sources +Vs2 and -Vs1 is point-grounded, or is connected to the ground power source GND at close range, which keeps the discharge current from flowing through the ground power source line GND, and therefore the generation of noise that would disrupt the potential of the ground power source GND is prevented.

[0048]

Also, a large-capacity capacitor such as an electrolytic capacitor that supplies a charge is usually connected along the wiring path from the power source output to the switching element in order to prevent a voltage drop during the supply of peak current and to compensate the voltage level. As shown in Figure 9, with this embodiment, this capacitor C1 is directly connected between the power source +Vs2 and the power source -Vs1, but is not connected to the ground power source line GND. Doing this prevents the gas discharge current from flowing to the ground power source line GND. After the flow of gas discharge current is finished, the potential on the Y electrode side is returned to the potential of the power source -Vs1, which concludes the application of the sustaining voltage pulses SUSP to the Y electrode side. Here again, the short-circuit current flowing between the two electrodes does not flow through the ground power source line, and only flows to the reference power source -Vs1.

[0049]

The sustaining voltage pulses SUSP are similarly applied to the X electrode side in the following timing, but the gas discharge current here just reverses its direction within the panel, and otherwise exactly the same effect is obtained.

[0050]

With this embodiment, the potential of the address electrode is maintained at the ground potential GND while the above-mentioned sustaining voltage pulses are being continuously applied alternately to the X and Y electrodes. Therefore, the difference in potential between the address electrodes and the sustaining electrodes X and Y is the difference between the ground potential GND and the potential of the power source +Vs2 or the power source -Vs1, and if the absolute value of the power source +Vs2 or -Vs1 is set to be equal, then the potential difference will be cut by half compared to a conventional method, excessive

storage of charges on the address electrode can be prevented, and it will be possible to ameliorate malfunctions such as erroneous discharge.

[0051]

Next, with this embodiment, the same drive method can also be applied to the full-write pulses WP used to periodically activate the display cells over the entire panel. Specifically, at the same time the full-write period W is entered, the reference voltage -Vw1 is applied all at once to the Y electrodes and X electrodes to lower the potential thereof to the ground potential. The potential of the power source +Vwx is then applied to the X electrode side from this reference voltage -Vw1, which generates a full-write discharge. The current resulting from this full-write discharge flows within the drive circuit in Figure 9 along the path comprising the switching element Q15 on the X electrode side on the supply power source side of the power source +Vwx, the X electrodes, the discharge cells, and the Y electrodes, and then through the switching elements D1 and Q11 on the Y electrode side to the reference power source -Vw1. At this point, the ground terminal side of the two power sources +Vwx and -Vw1 is point-grounded, or is connected to the ground power source GND at close range, which keeps the discharge current from flowing through the ground power source line GND. Therefore, there is no generation of noise that would disrupt ground potential GND. At the conclusion of the full-write period, the Y electrodes and X electrodes both return to the potential of the ground power source GND, and the potential difference between all of the electrodes is reset to zero.

[0052]

In the full-erase period, a flat-wave pulse of the voltage +Vey level is applied from the Y electrode side, this being applied by actuating the switching element Q14 on the Y electrode side, and a flat waveform is obtained by a method in which a transistor Q14 with a higher on-resistance

is used, or in which a resistor (not shown) is inserted in series on the output side of the transistor Q14.

[0053]

[Second Embodiment]

Figure 10 is a diagram illustrating the drive waveform in the second embodiment, while Figure 11 is a diagram illustrating the drive circuit in the second embodiment. The same reference numbers will be used to refer to those components that correspond to the first embodiment. This second embodiment involves the use of sustaining pulses SUSP or full-write pulses WP with reversed polarity from that in the first embodiment. Also, the write pulses are supplied to the Y electrodes during full-write. Finally, positive power sources +Vw2 and +Vs2 are used as the reference power sources.

[0054]

With this embodiment, the reference voltage in the sustaining period is set to the power source +Vs2 of positive polarity, and sustaining voltage pulses SUSP of negative polarity whose potential is changed from the level of this power source +Vs2 to the peak voltage -Vs1 is applied to the X and Y electrodes.

[0055]

The advantage here is that the voltage pulses generated by the discharge have a potential of negative polarity, so the positive ions of the discharge gas accumulate on the Y and X electrode side, which are the sustaining electrodes, during the discharge generation, and electrons accumulate on the address electrode side across from these electrodes. It is therefore possible to avoid the positive ion collisions with the fluorescent material on the address electrode side that occurred in the past. The benefit in this is a longer service life. Also, a write voltage -Vwy of negative polarity is applied to the Y electrodes from the reference voltage +Vw2 of positive polarity in an effort to obtain the

same effect in the application of the full-write voltage pulses WP, rather than just the sustaining voltage pulses SUSP.

[0056]

[Third Embodiment]

Figure 12 is a diagram illustrating the drive waveform in the third embodiment, while Figure 13 is a diagram illustrating the drive circuit in the third embodiment. In this example, the sustaining period is the same as in the first embodiment (Figure 8), the X and Y electrodes are changed to the negative reference power source -Vs1, and sustaining pulses SUSP of the positive power source +Vs2 are applied thereto. Meanwhile, the application of the reference voltage during the full-write period is different from that in the first embodiment.

[0057]

As shown in Figure 12, at the same time the full-write period W is entered, separate reference voltages are applied, with the reference voltage -Vw1 of negative polarity to the Y electrodes and the reference voltage +Vw2 of positive polarity to the X electrodes. Thus using separate reference voltages allows the voltage between the electrodes required for a write operation to be added to the reference voltage, so it is possible to reduce voltage amplitude during the application of the power source +Vwx from the reference voltage +Vw2 as the write pulse WP. This allows the various voltage changes to be reduced, permitting better reduction of noise such as higher harmonics.

[0058]

As shown in the drive circuit in Figure 13, the transistor Q15 is conductive during full-write to change the X electrodes first to the reference power source +Vw2, and then the transistor Q18 is conductive to change the X electrodes to the power source +Vwx. The drive circuit on the Y electrode side is configured the same as in the first

embodiment.

[0059]

[Fourth Embodiment]

Figure 14 is a diagram illustrating the drive waveform in the fourth embodiment, while Figure 15 is a diagram illustrating the drive circuit in the fourth embodiment. In this example, the sustaining period is the same as in the second embodiment (Figure 10), the X and Y electrodes are changed to the positive reference power source +Vs2, and sustaining pulses SUSP of the negative power source -Vs1 are applied thereto. Meanwhile, the application of the reference voltage during the full-write period is different from that in the second embodiment, and is of the opposite polarity as in the third embodiment (Figure 12).

[0060]

In this example, the drive during the full-write period is such that separate reference voltages are applied, with the reference voltage -Vw1 of negative polarity to the Y electrodes and the reference voltage +Vw2 of positive polarity to the X electrodes, and the power source -Vwy is applied using the write voltage required for a write operation as the write pulses WP from the Y electrode side. Since reference voltage of opposite polarity is shared as part of the write voltage, the drive voltage of the various electrodes is lower, allowing noise such as higher harmonics to be decreased.

[0061]

In the drive circuit of Figure 15, the drive circuit on the Y electrode side is provided with a transistor Q11 that applies a negative reference power source -Vw1, and a transistor Q19 that applies a negative power source -Vwy for writing. The drive circuit on the X electrode side is the same as in the second embodiment (Figure 11).

[0062]

[Fifth Embodiment]

Figure 16 is a diagram illustrating the drive waveform in the fifth embodiment, while Figure 17 is a diagram illustrating the drive circuit in the fifth embodiment. In this example, the sustaining period is the same as in the second embodiment (Figure 10) and the fourth embodiment (Figure 14), the X and Y electrodes are changed to the positive reference power source +Vs2, and sustaining pulses SUSP of the negative power source -Vs1 are applied thereto. Meanwhile, the application of the reference voltage during the full-write period, and the application of the write voltage, are performed by pulses that are both of opposite polarity with respect to the X and Y electrodes.

[0063]

In the first to fourth embodiments, the write pulses were only applied to either the Y electrodes or the X electrodes, but in this embodiment, writing is performed with the combined voltage from both of these electrodes. Specifically, along with the start of the full-write period, the reference voltage -Vw1 of negative polarity is applied to the Y electrodes and the reference voltage +Vw2 of positive polarity to the X electrodes, after which write pulses Yw of negative polarity and of the level of the power source -Vwy are applied from the Y electrode side, while write pulses Xw of positive polarity and of the level of the power source +Vwx is applied from the X electrode side, and a write discharge is generated by this combined voltage. With this method, the amplitude of the voltage pulses variously applied to the two electrodes can be reduced by nearly half, and induced noise can also be kept low. As shown in Figure 17, transistors Q15 and Q18 are provided to the drive circuit of the X electrodes, and transistors Q11 and Q19 are provided to the drive circuit of the Y electrodes, making possible the application of the above-mentioned full-write pulses.

[0064]

[Sixth Embodiment]

Figure 18 is a diagram illustrating the drive waveform in the sixth embodiment, while Figure 19 is a diagram illustrating the drive circuit in the sixth embodiment. In this example, the sustaining period and the full-write period are both configured with the same waveforms as in the first embodiment. However, a power source with a similar voltage level is shared in a plurality of drive-use power sources, reducing the types thereof, making the drive circuit more compact, and lowering cost. Specifically, the sustaining voltage of positive polarity is shared with the address voltage Va on the address side, and the sustaining voltage of negative polarity is shared with the Y electrode reference voltage -Vmy in the address period and with the reference voltage -Vmy in the full-write period. As a result, only five types of power source are required, comprising the above-mentioned two types of common power source Va and -Vmy, and three types of special-purpose power source, the erase power source +Vey on the Y electrode side, the write power source +Vwx on the X electrode side, and scanning-use power source -Vy on the Y electrode side. This makes the configuration simpler than in the first embodiment.

[0065]

In relation to this, as shown in Figure 19, the number of drive transistors in the drive circuit can also be reduced from that in the first embodiment. Therefore, the overall product is much more compact and inexpensive.

[0066]

This sharing of the drive power sources in the sixth embodiment can also be accomplished in the second to fifth embodiments. In this case, power sources with the same polarity and similar potential can be shared, allowing the power sources and the drive circuit to be simplified.

[0067]

[Seventh Embodiment]

Figure 20 is a diagram illustrating the drive waveform in the seventh embodiment, while Figure 21 is a diagram illustrating the drive circuit in the seventh embodiment. This example utilizes the third drive method illustrated in Figure 6, and involves the driving of the sustaining discharge and full-write X and Y electrodes.

[0068]

First, in the sustaining discharge period SUS, as shown in Figure 20, the two electrodes are driven from the ground potential to the negative reference power source -Vs1. One of the electrodes is driven from this state to the more negative power source -Vs3, and the other electrode is simultaneously driven to the positive power source +Vs2. As a result, as was described for the third drive method, the combination of sustaining pulses applied to the various electrodes results in the voltage required for sustaining discharge being applied between the two electrodes. This discharge current does not, however, flow to the ground power source GND.

[0069]

Similarly, in the full-write period, as shown in Figure 20, the two electrodes are driven from the ground potential to the negative reference power source -Vs1. The X electrodes are driven to the positive power source +Vwx to apply write pulses Xw, and the Y electrodes are driven to the negative power source -Vwy to apply the write pulses Yw of the opposite polarity. The combination of these pulses of opposite polarity results in the application of a sufficiently large write voltage between the two electrodes, and the generation of a full-panel discharge. Here again, the discharge current does not flow to the ground power source. In the full-write period, the pulses applied to the various electrodes are also small, so accompanying noise such as higher harmonics can be reduced.

[0070]

Figure 21 shows the drive transistors and power sources used to perform the above-mentioned electrode drive. These drive transistors are controlled by a control circuit so as to realize the drive waveforms of Figure 20.

[0071]

[Eighth Embodiment]

Figure 22 is a diagram illustrating the drive waveform in the eighth embodiment, while Figure 23 is a diagram illustrating the drive circuit in the eighth embodiment. This example utilizes the fourth drive method illustrated in Figure 7, and involves the driving of the sustaining discharge and full-write X and Y electrodes. Specifically, this drive method has the opposite polarity as in the seventh embodiment.

[0072]

First, in the sustaining discharge period SUS, as shown in Figure 22, the two electrodes are driven from the ground potential to the positive reference power source +Vs1. One of the electrodes is driven from this state to the more positive power source +Vs2, and the other electrode is simultaneously driven to the negative power source -Vs3. As a result, as was described for the fourth drive method, the combination of sustaining pulses applied to the various electrodes results in the voltage required for sustaining discharge being applied between the two electrodes. This discharge current does not, however, flow to the ground power source GND.

[0073]

Similarly, in the full-write period, as shown in Figure 22, the two electrodes are driven from the ground potential to the positive reference power source +Vs1. The X electrodes are driven to the positive power source +Vwx to apply write pulses Xw, and the Y electrodes are driven to the negative power source -Vwy to apply the write pulses Yw of the opposite polarity. The combination of these pulses

of opposite polarity results in the application of a sufficiently large write voltage between the two electrodes, and the generation of a full-panel discharge. Here again, the discharge current does not flow to the ground power source. In the full-write period, the pulses applied to the various electrodes are also small, so accompanying noise such as higher harmonics can be reduced.

[0074]

Figure 23 shows the drive transistors and power sources used to perform the above-mentioned electrode drive. These drive transistors are controlled by a control circuit so as to realize the drive waveforms of Figure 22.

[0075]

Embodiments of the present invention were described above using a three-electrode type of surface discharge AC-PDP as an example, but within the scope of the present invention, it can be similarly applied to conventional opposing discharge type AC-PDP device as well.

[0076]

[Effect of the Invention]

With the present invention, it is possible to prevent the large peaked current that accompanies discharge from flowing to the ground power source line by driving the electrodes to a separate power source from a power source that is different from the ground power source when discharge pulses are applied. Therefore, noise to the ground potential is prevented, and problems such as the attendant malfunctions, distortion of the drive waveform, interference with electromagnetic radiation, and so on can be solved.

[0077]

Also, the voltage can be kept low between address electrodes and sustaining electrodes consisting of X and Y electrodes during gas discharge generation by maintaining

the address electrodes at an intermediate potential with respect to the amplitude of the discharge pulses. Therefore, charges can be prevented from accumulating excessively on the dielectric layer surfaces on the address electrode side, and the accompanying erroneous discharges can be prevented.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig.1]

Figure 1 is a plan view of a three-electrode surface discharge AC type of PDP device in an embodiment;

[Fig.2]

Figure 2 is a cross section of the PDP in Figure 1;

[Fig.3]

Figure 3 is a block diagram of the drive circuit in the PDP in Figures 1 and 2;

[Fig.4]

Figure 4 is a diagram illustrating the first drive method in this embodiment;

[Fig.5]

Figure 5 is a diagram illustrating the second drive method in this embodiment;

[Fig.6]

Figure 6 is a diagram illustrating the third drive method in this embodiment;

[Fig.7]

Figure 7 is a diagram illustrating the fourth drive method in this embodiment;

[Fig.8]

Figure 8 is a diagram illustrating the drive waveform in the first embodiment;

[Fig.9]

Figure 9 is a diagram illustrating the drive circuit in the first embodiment;

[Fig.10]

Figure 10 is a diagram illustrating the drive waveform in the second embodiment;

[Fig.11]

Figure 11 is a diagram illustrating the drive circuit

in the second embodiment;

[Fig.12]

Figure 12 is a diagram illustrating the drive waveform in the third embodiment;

[Fig.13]

Figure 13 is a diagram illustrating the drive circuit in the third embodiment;

[Fig.14]

Figure 14 is a diagram illustrating the drive waveform in the fourth embodiment;

[Fig.15]

Figure 15 is a diagram illustrating the drive circuit in the fourth embodiment;

[Fig.16]

Figure 16 is a diagram illustrating the drive waveform in the fifth embodiment;

[Fig.17]

Figure 17 is a diagram illustrating the drive circuit in the fifth embodiment;

[Fig.18]

Figure 18 is a diagram illustrating the drive waveform in the sixth embodiment;

[Fig.19]

Figure 19 is a diagram illustrating the drive circuit in the sixth embodiment;

[Fig.20]

Figure 20 is a diagram illustrating the drive waveform in the seventh embodiment;

[Fig.21]

Figure 21 is a diagram illustrating the drive circuit in the seventh embodiment;

[Fig.22]

Figure 22 is a diagram illustrating the drive waveform in the eighth embodiment;

[Fig.23]

Figure 23 is a diagram illustrating the drive circuit in the eighth embodiment; and

[Fig.24]

Figure 24 is a diagram illustrating the drive waveform of a conventional PDP.

[Explanation of Reference Numerals]

12 address electrode

16 X electrodes

18 Y electrodes

30 control circuit

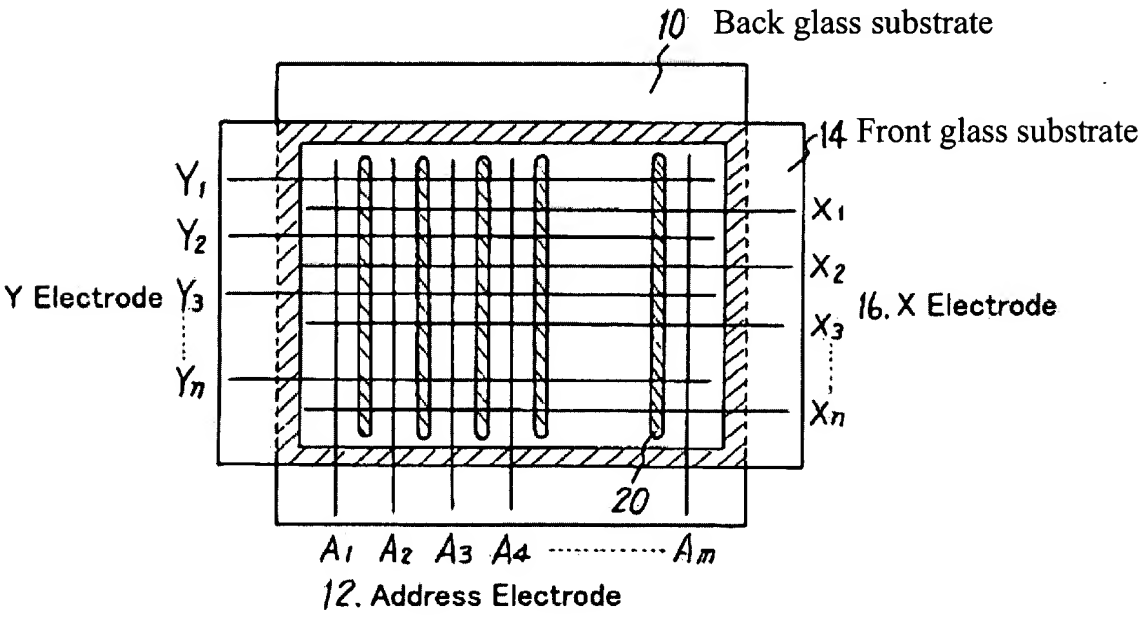
GND ground power source

-V1, +V2, -V3 power source that is different from ground power source

[NAME OF DOCUMENT] DRAWINGS

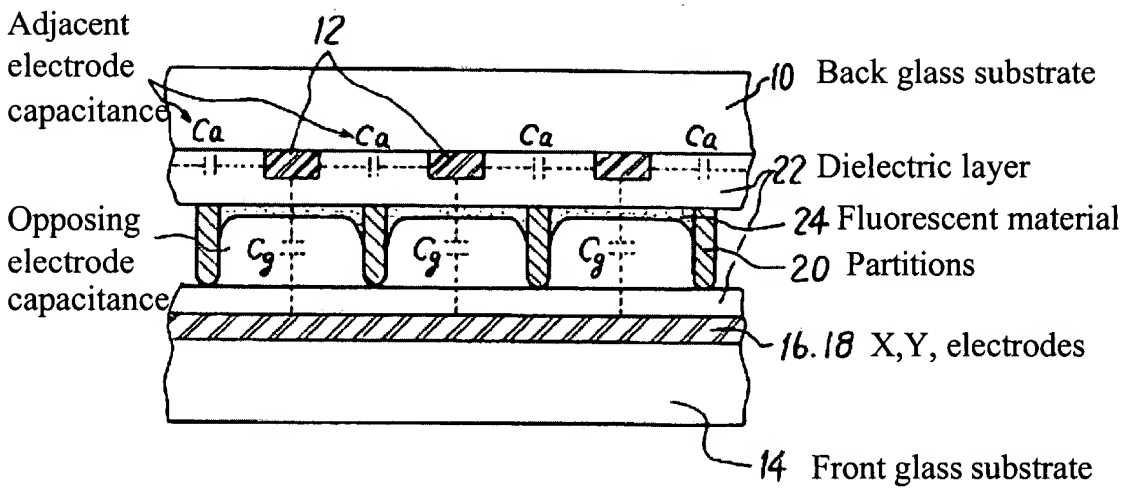
[FIG.1]

Plan view of surface discharge AC type of PDP device



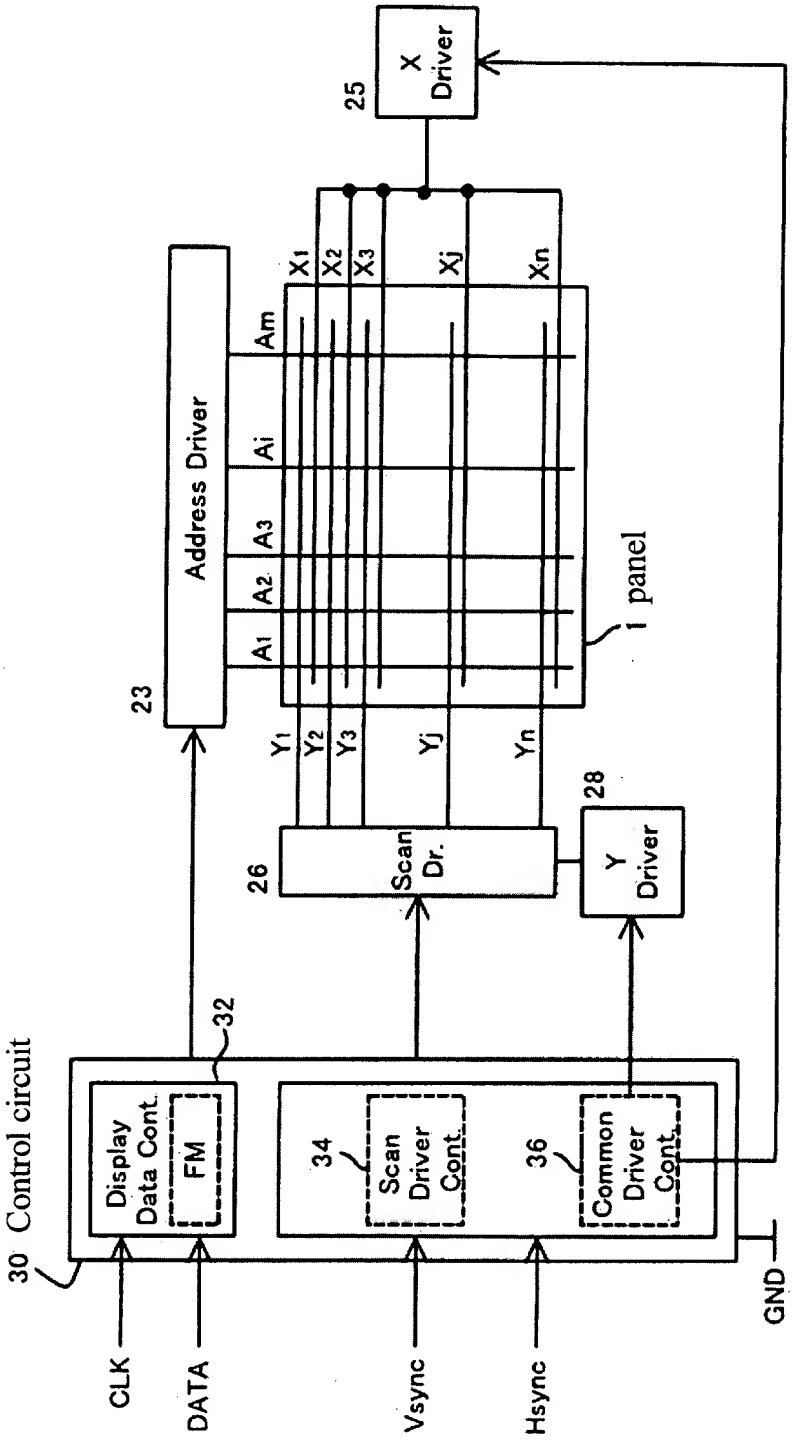
[FIG.2]

Cross section of surface discharge AC type of PDP device



Block diagram of surface discharge AC type of PDP drive circuit

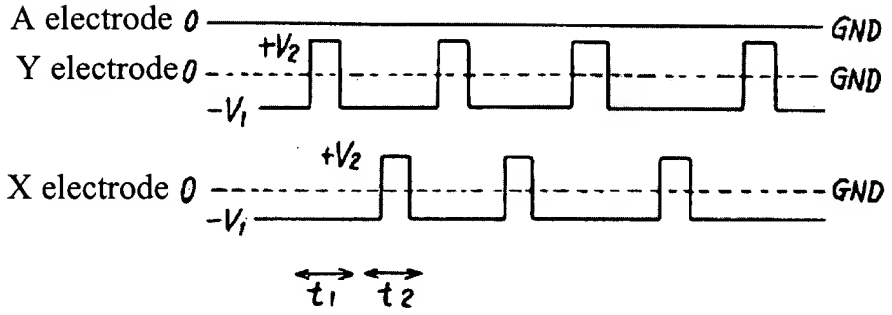
[FIG.3]



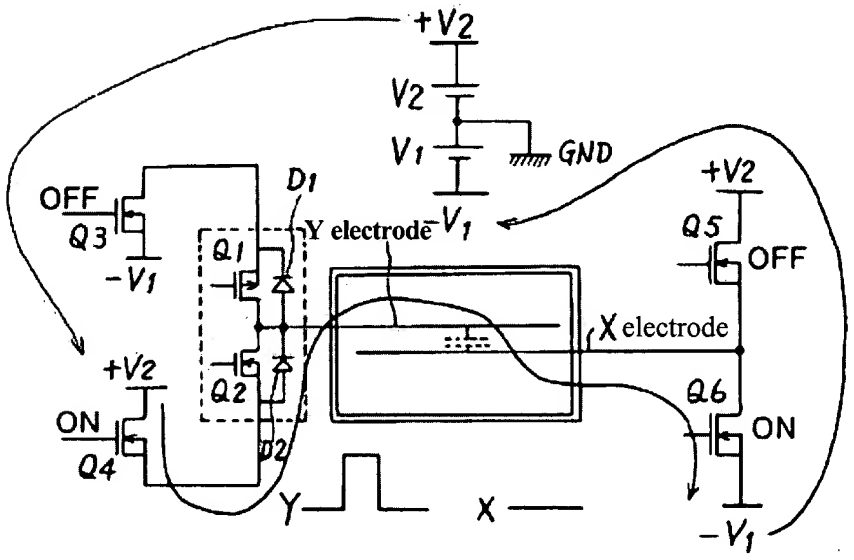
[FIG.4]

Drive Method (1)

(a) Drive Wave Form



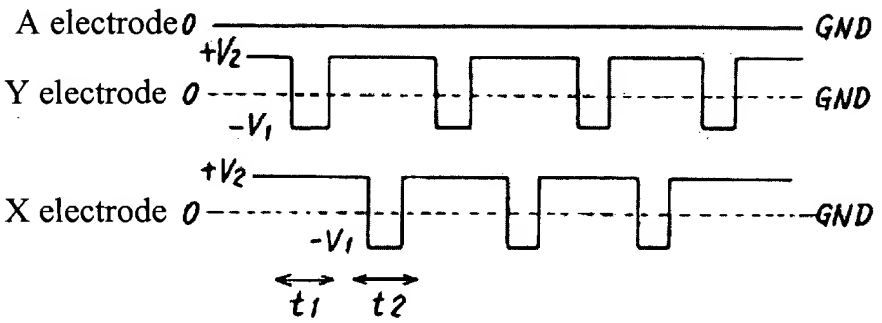
(b) Drive Circuit



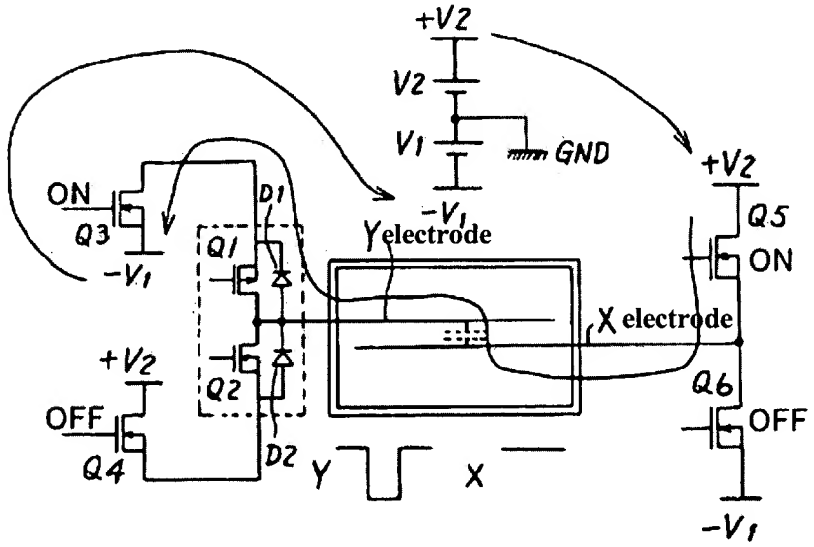
[FIG.5]

Drive Method (2)

(a) Drive Wave Form



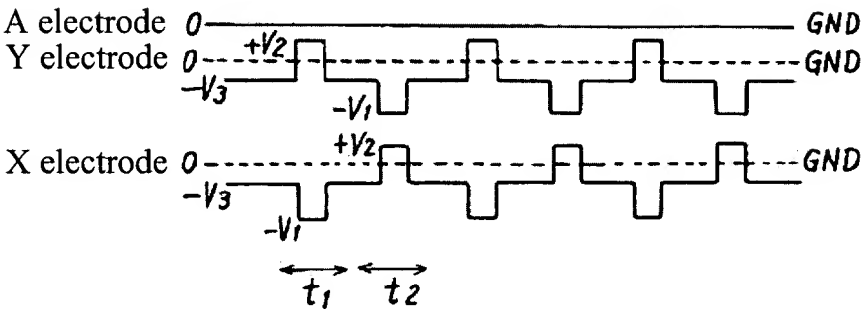
(b) Drive Circuit



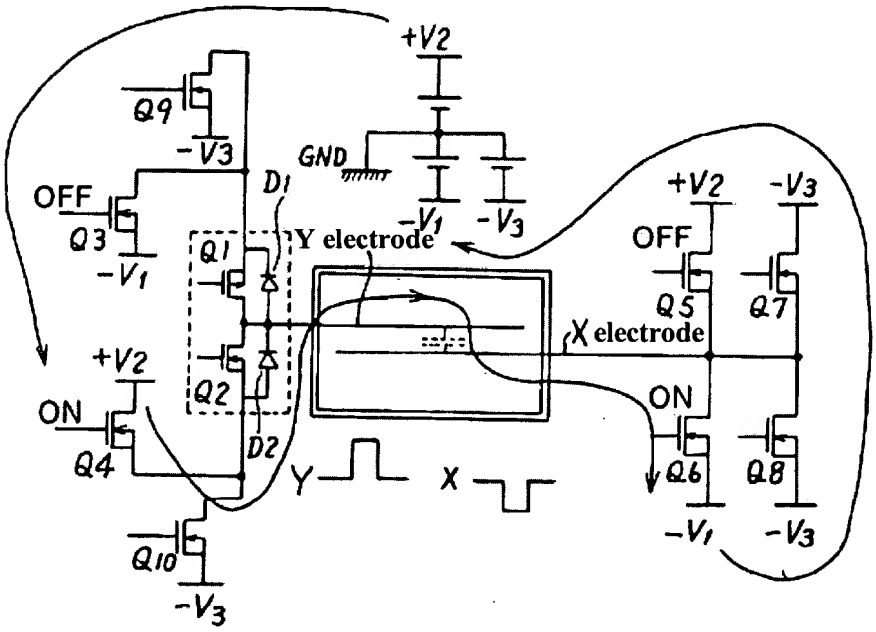
[FIG.6]

Drive Method (3)

(a) Drive Wave Form



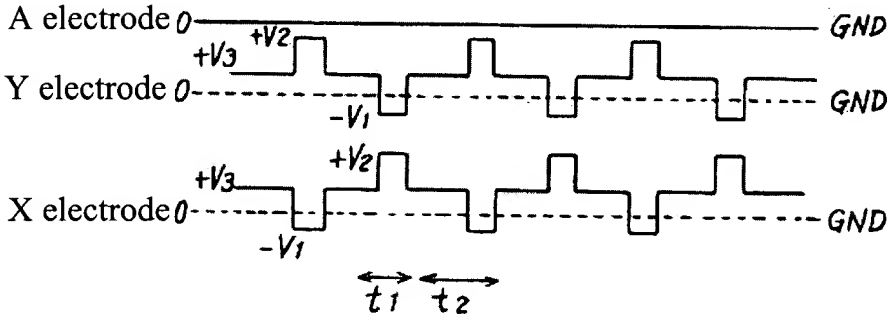
(b) Drive Circuit



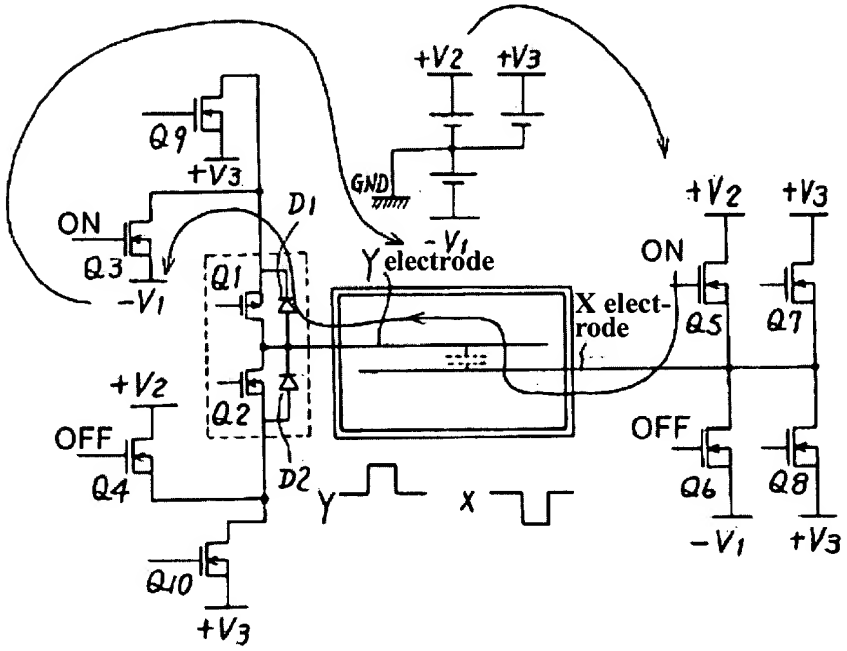
[FIG.7]

Drive Method (4)

Drive Wave Form

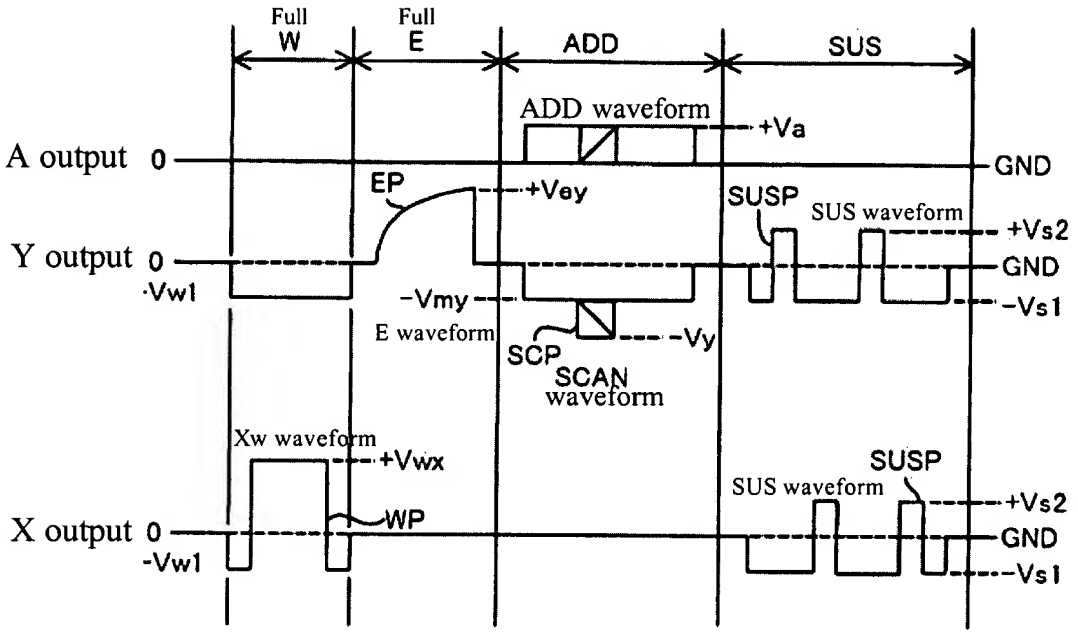


(b) Drive Circuit

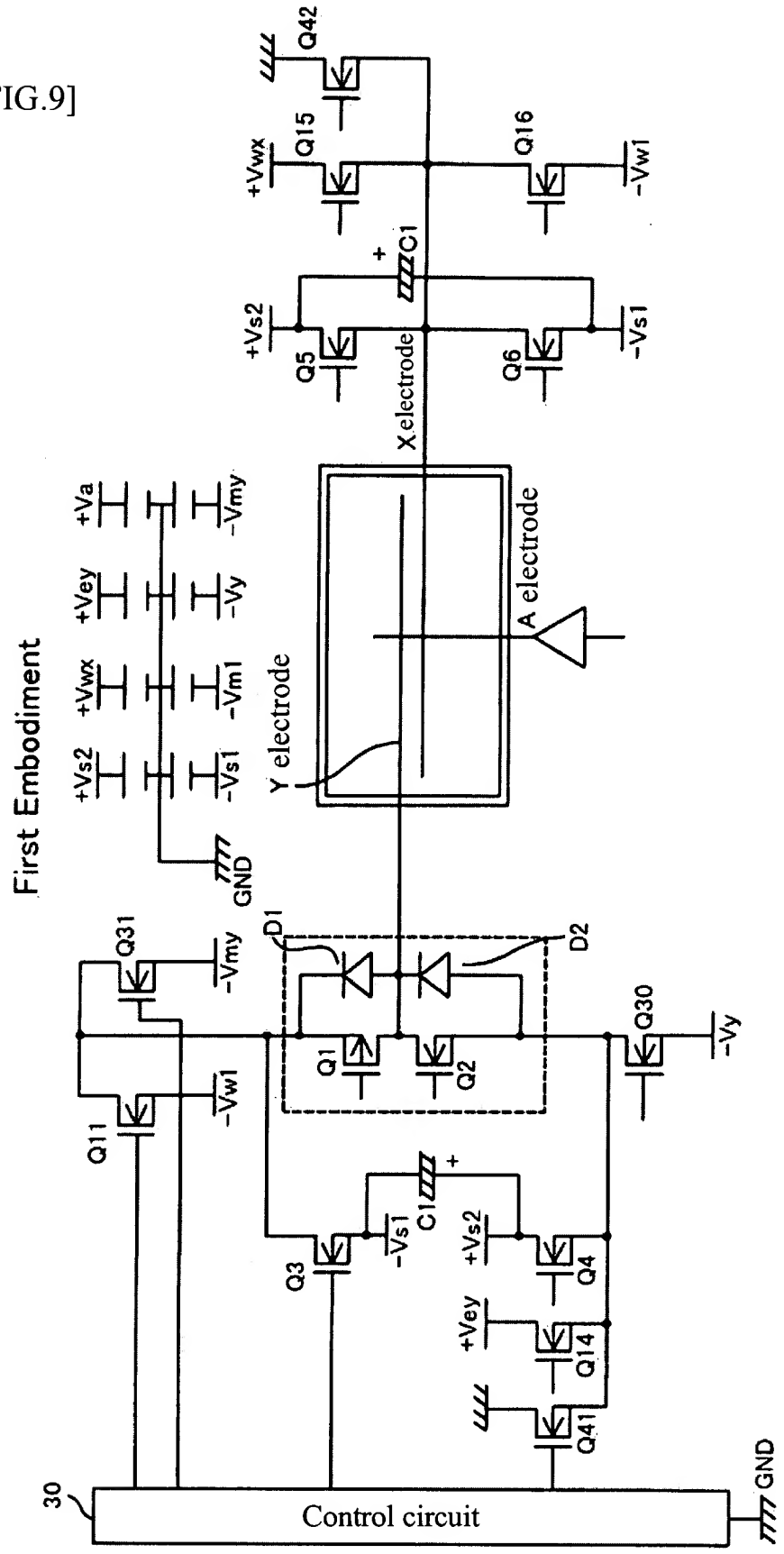


[FIG.8]

First Embodiment

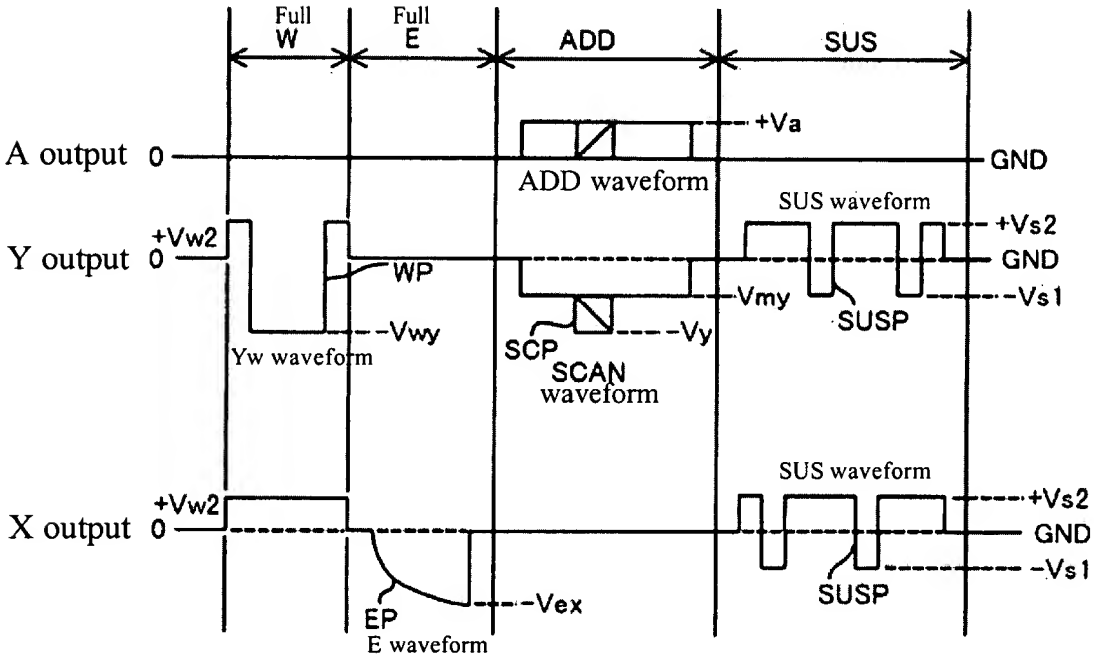


[FIG.9]

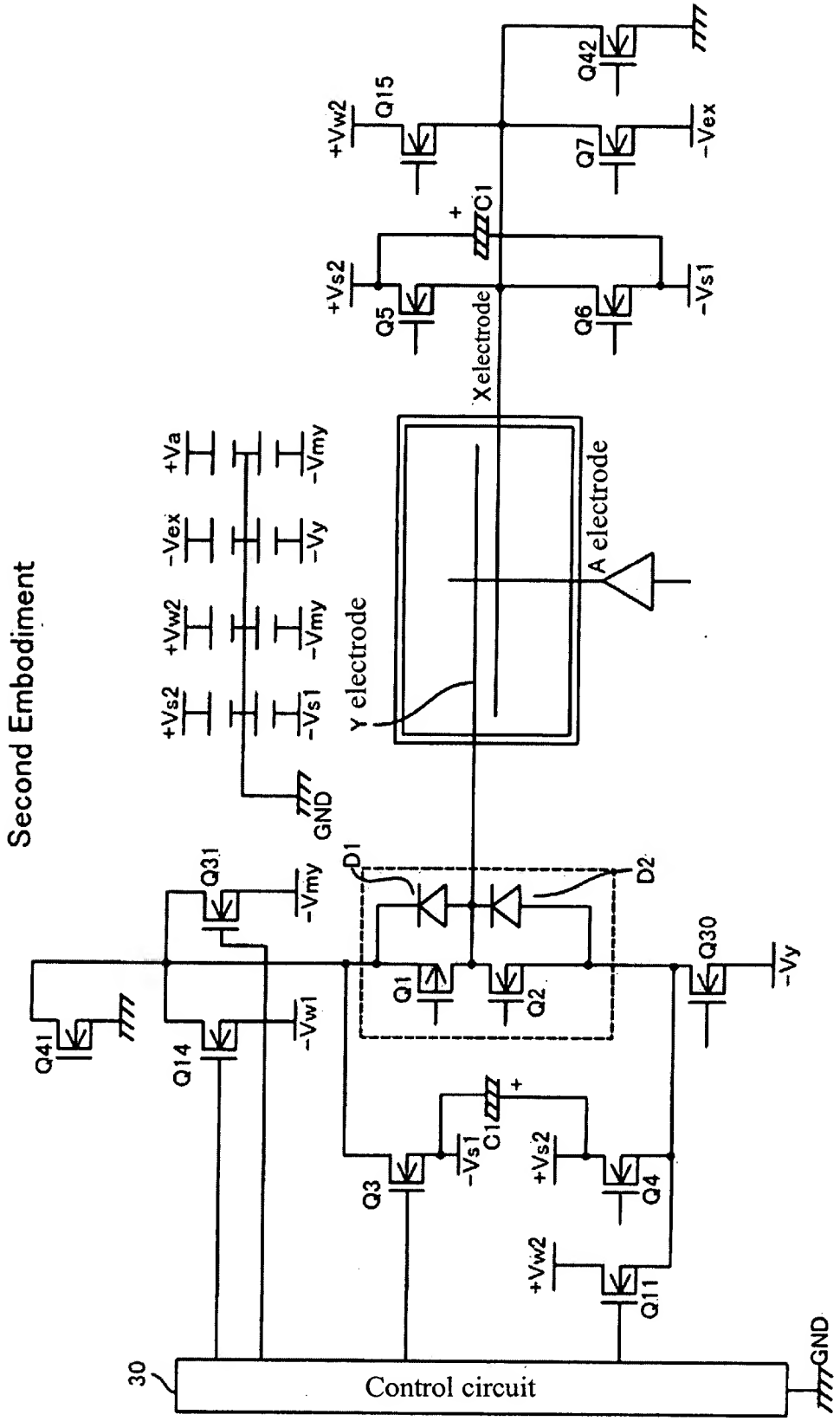

First Embodiment
Q42
Q15
Q16
+Vwx
-Vw1
C1
+Vs2
-Vs1
Q5
Q6
X electrode
A electrode
Y electrode
+Va
+Vey
+Vwx
+Vs2
-Vmy
-Vy
-Vm1
-Vs1
GND
Q31
-Vmy
D1
D2
Q30
-Vy
Q1
Q2
-Vw1
Q11
C1
Q3
-Vs1
+Vs2
Q4
+Vey
Q14
Q41
30
Control circuit
GND

[FIG.10]

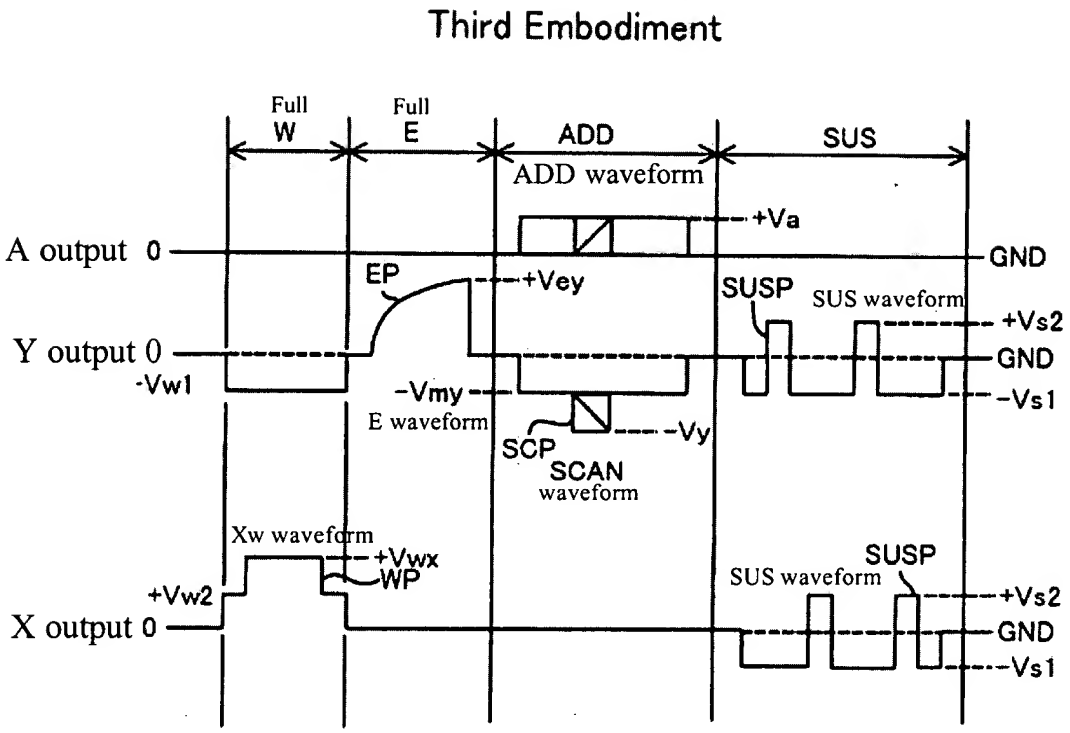
Second Embodiment



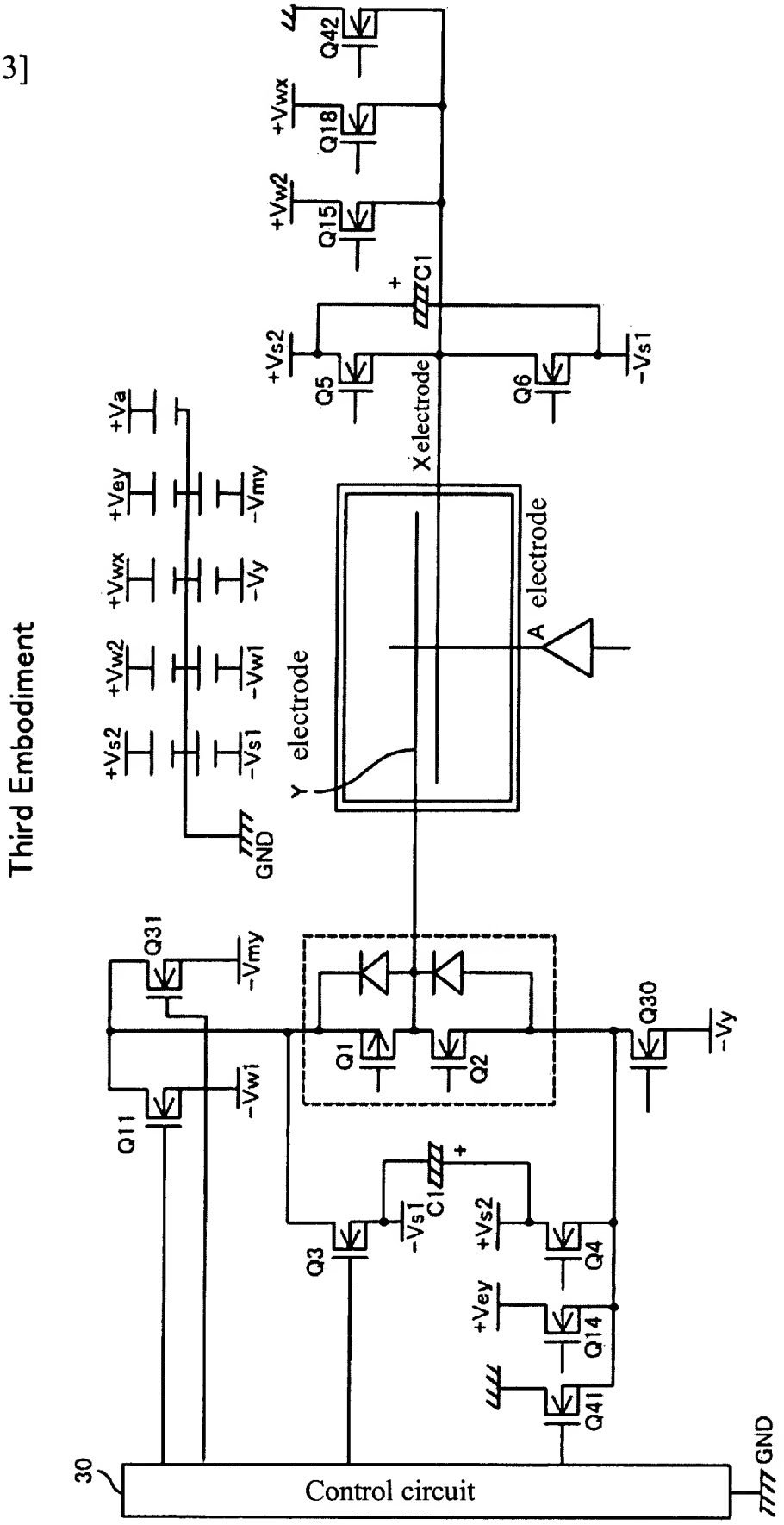
[FIG.11]


Second Embodiment
Control circuit
30
GND
X electrode
Y electrode
A electrode
+Vw2
Q15
Q42
Q7
-Vex
C1
+Vs2
Q5
Q6
-Vs1
+Va
-Vmy
-Vex
-Vy
+Vw2
-Vmy
+Vs2
-Vs1
GND
Q31
-Vmy
D1
D2
Q30
-Vy
Q1
Q2
Q41
Q14
-Vw1
Q3
-Vs1
C1
+Vs2
Q4
+Vw2
Q11

[FIG.12]

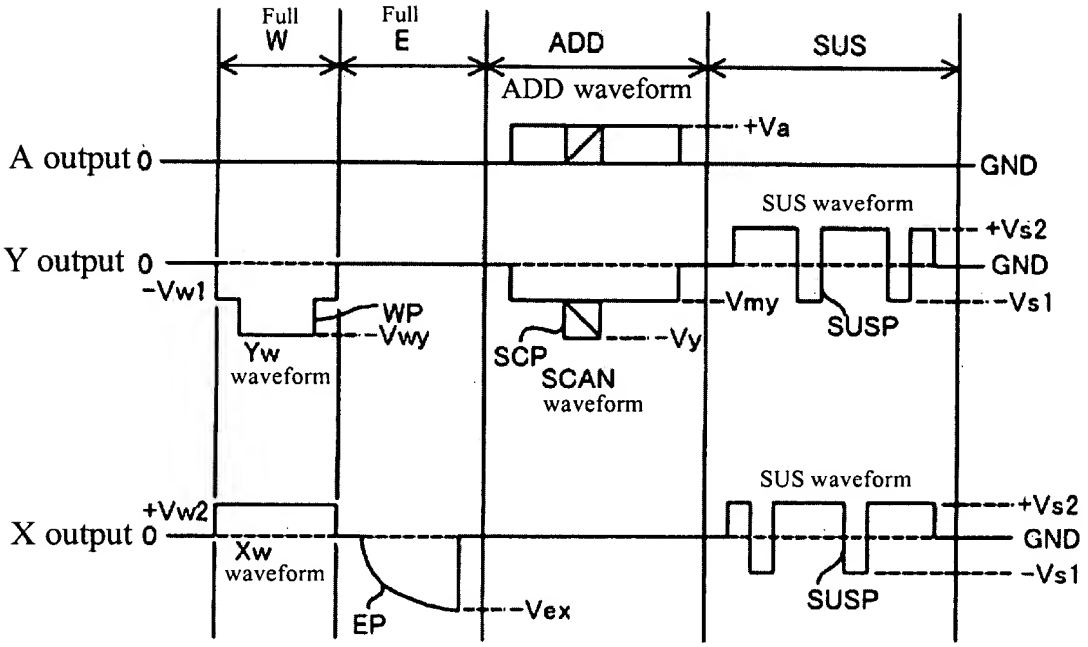

Third Embodiment
Full
W
Full
E
ADD
SUS
ADD waveform
+Va
A output 0
GND
EP
+Vey
SUSP
SUS waveform
+Vs2
Y output 0
GND
-Vw1
-Vmy
-Vs1
E waveform
-Vy
SCP
SCAN
waveform
Xw waveform
+Vwx
WP
SUSP
SUS waveform
+Vs2
+Vw2
X output 0
GND
-Vs1

[FIG.13]

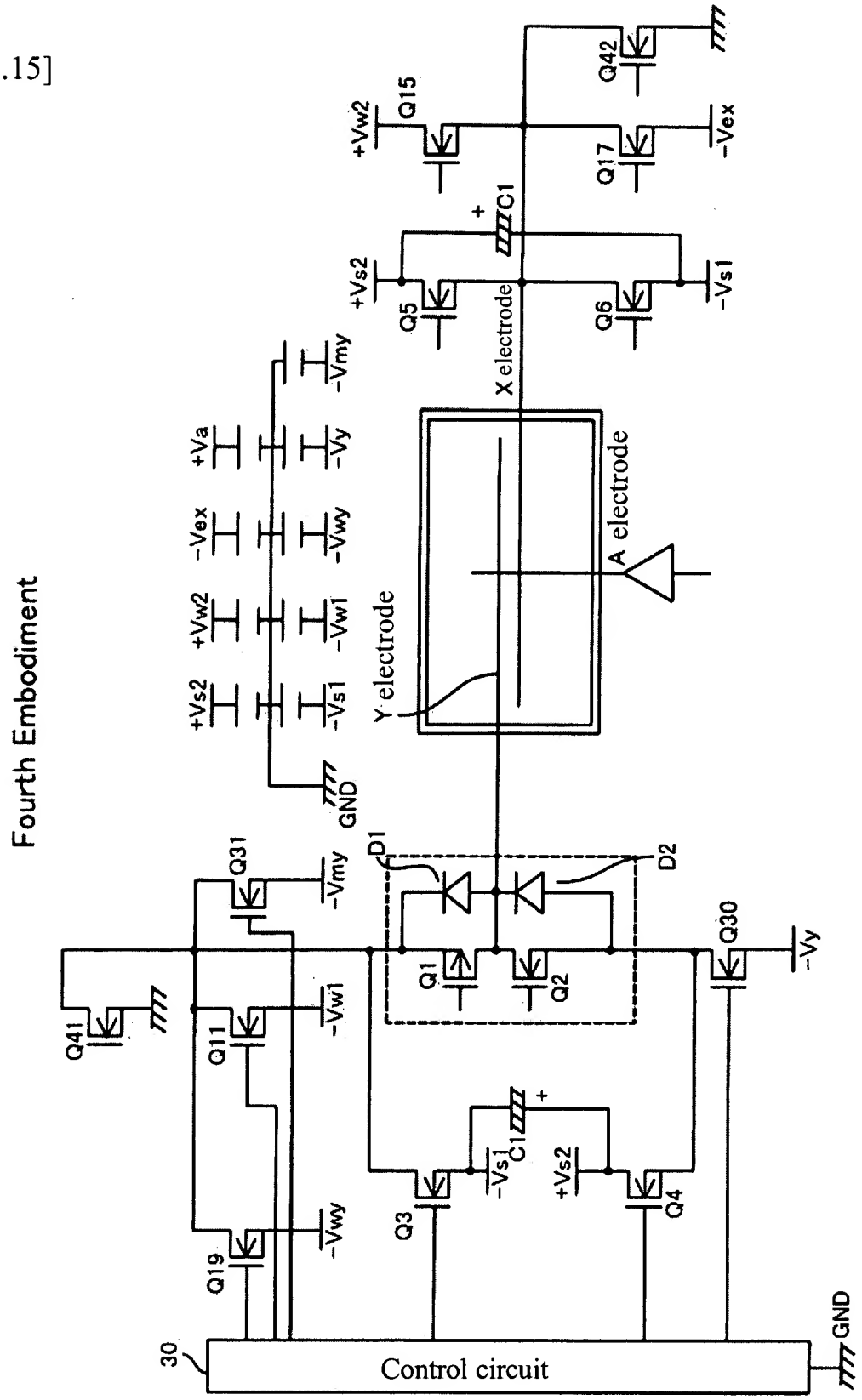

Third Embodiment
Q42
+Vwx
Q18
+Vw2
Q15
C1
+Vs2
Q5
X electrode
Q6
-Vs1
+Va
+Vey
-Vmy
+Vwx
-Vy
+Vw2
-Vwi
+Vs2
-Vs1
GND
Y electrode
A electrode
Q31
-Vmy
Q1
Q2
Q30
-Vy
Q11
-Vwi
C1
-Vs1
+Vs2
Q3
Q4
+Vey
Q14
Q41
30
Control circuit
GND

[FIG.14]

Fourth Embodiment

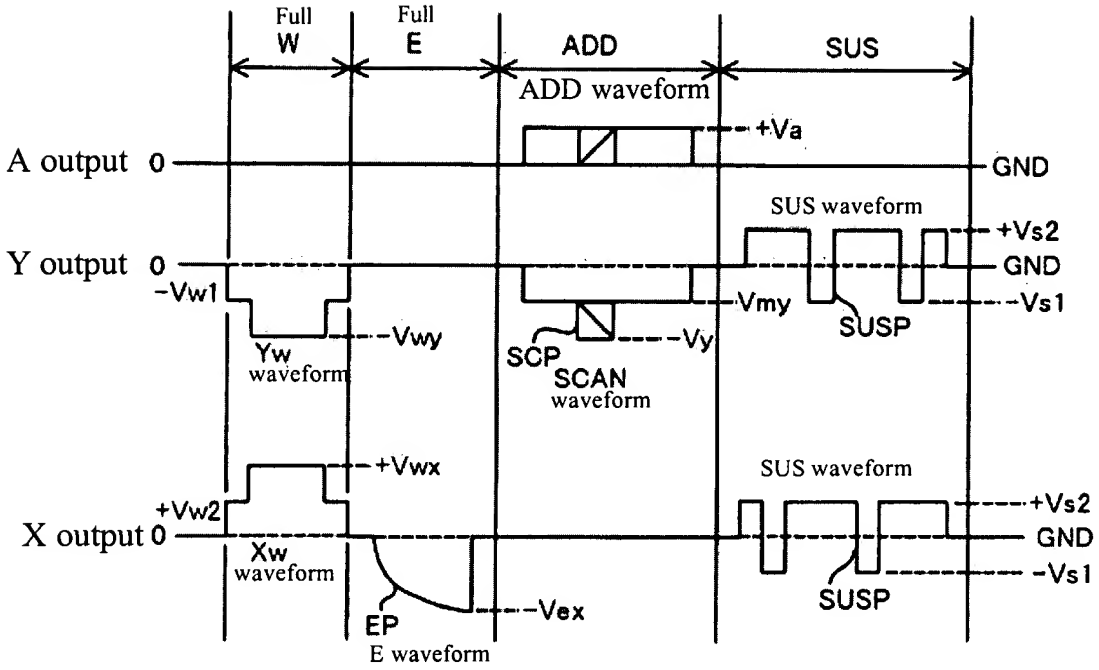


[FIG.15]

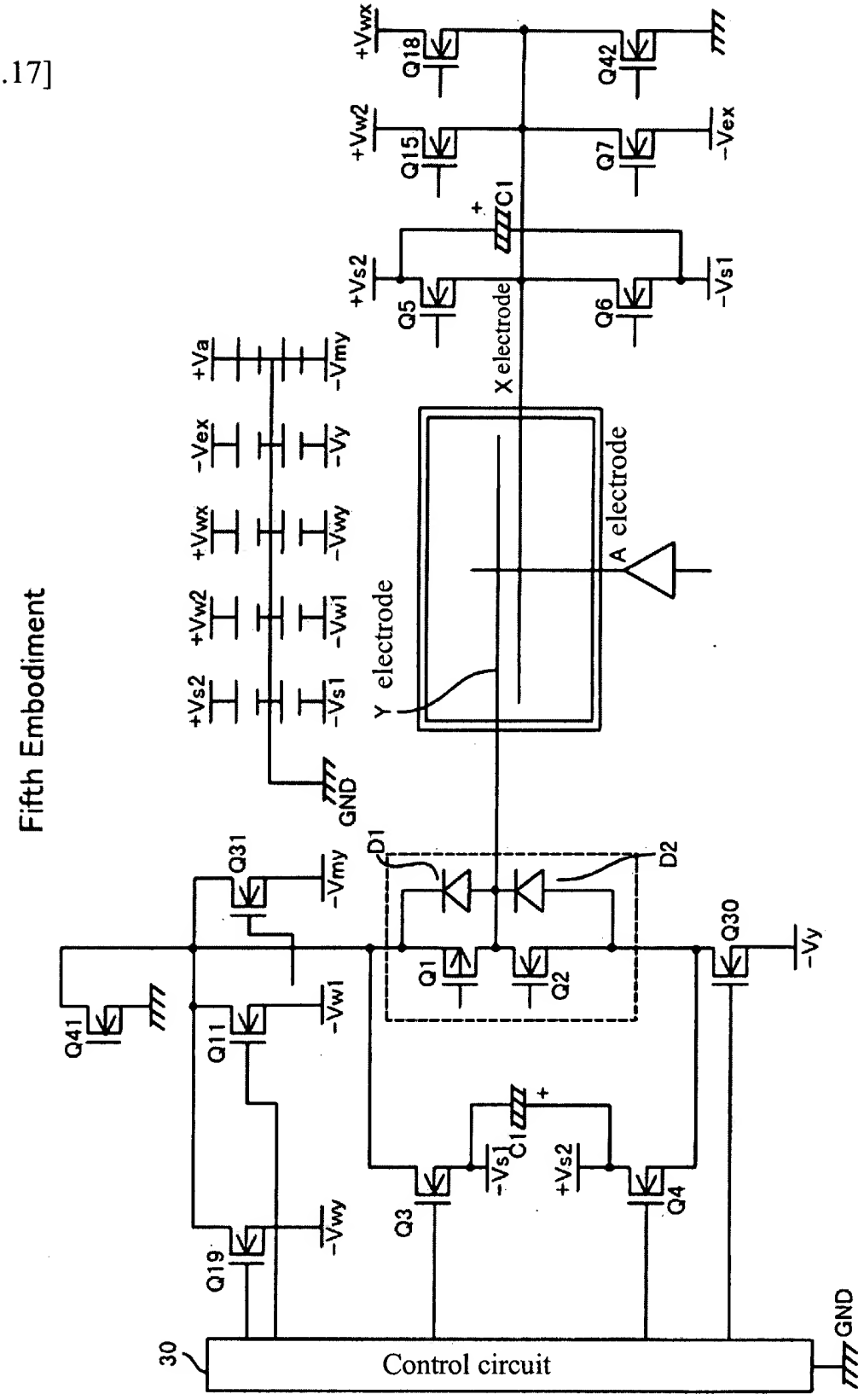

Fourth Embodiment
+Vw2
Q15
Q42
-Vex
Q17
C1
+Vs2
Q5
Q6
-Vs1
X electrode
-Vmy
+Va
-Vy
-Vex
-Vwy
+Vw2
-Vw1
+Vs2
-Vs1
GND
Y electrode
A electrode
D1
D2
Q31
-Vmy
Q30
-Vy
Q1
Q2
Q41
Q11
-Vw1
C1
-Vs1
+Vs2
Q3
Q4
Q19
-Vwy
30
Control circuit
GND

[FIG.16]

Fifth Embodiment

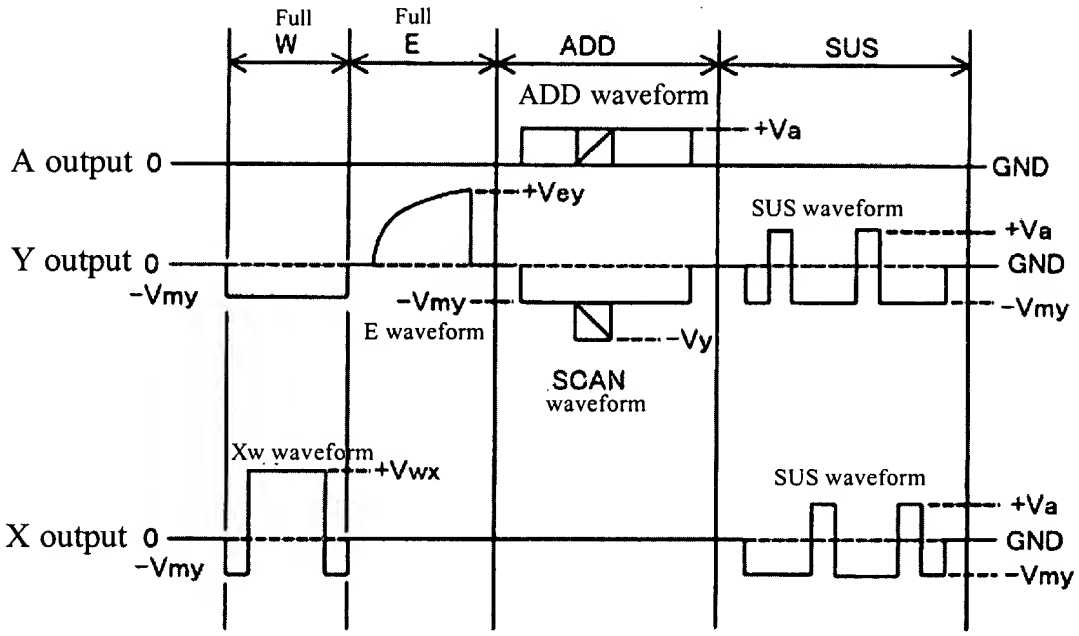


[FIG.17]

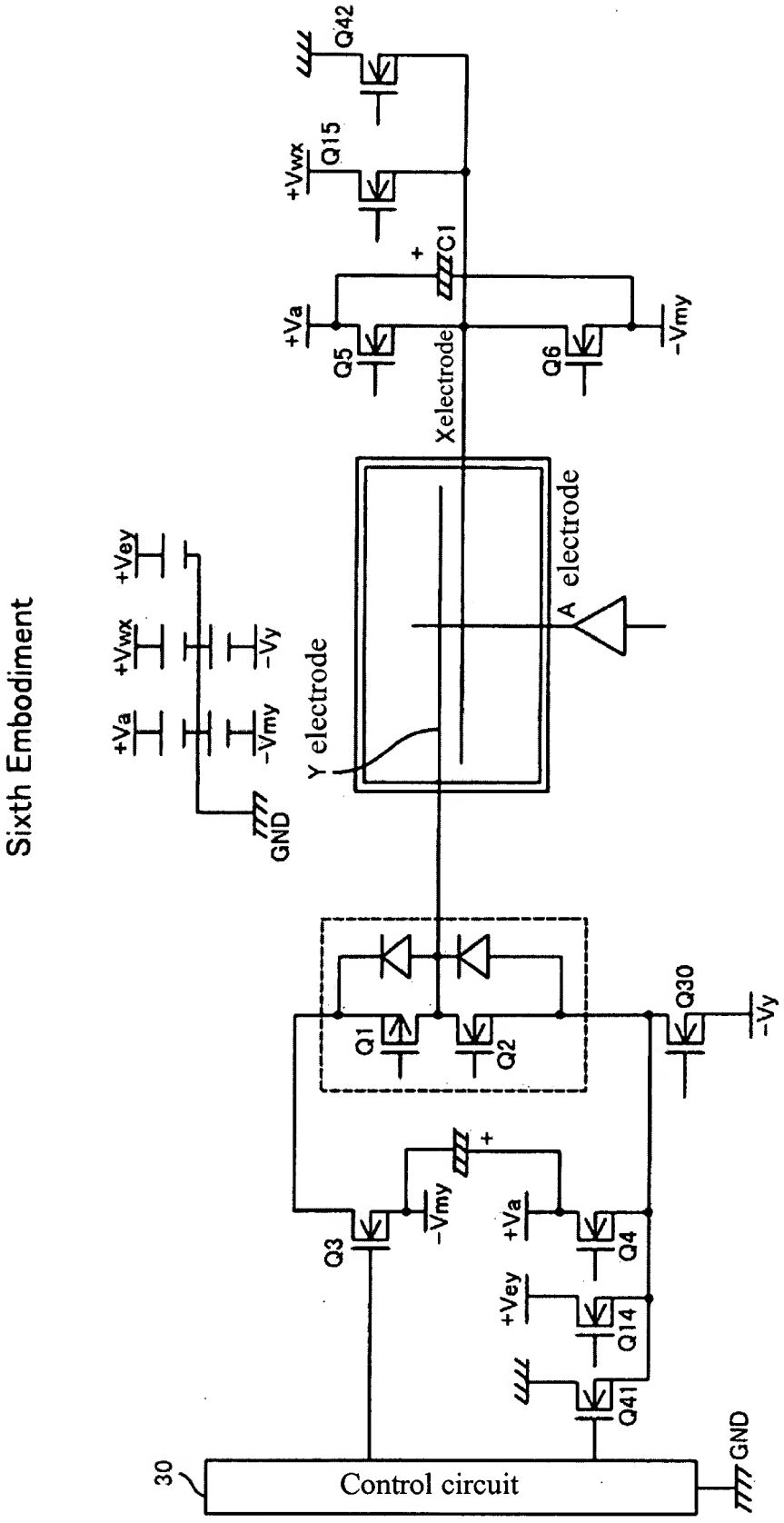

Fifth Embodiment
+Vwx
Q18
Q42
+Vw2
Q15
Q7
-Vex
C1
+Vs2
Q5
X electrode
Q6
-Vs1
+Va
-Vmy
-Vex
-Vy
+Vwx
-Vwy
+Vw2
-Vwi
+Vs2
-Vs1
GND
Y electrode
A electrode
D1
D2
Q31
-Vmy
Q30
-Vy
Q1
Q2
Q41
Q11
-Vwi
C1
-Vs1
+Vs2
Q3
Q4
-Vwy
Q19
30
Control circuit
GND

[FIG.18]

Sixth Embodiment

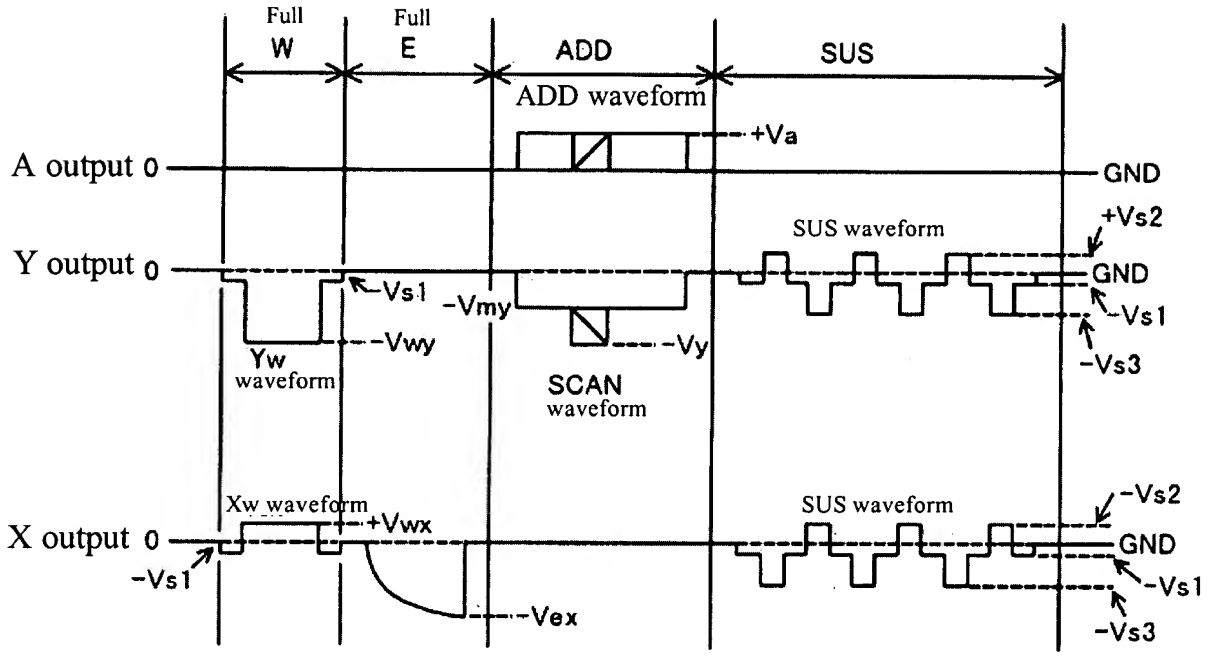


[FIG.19]

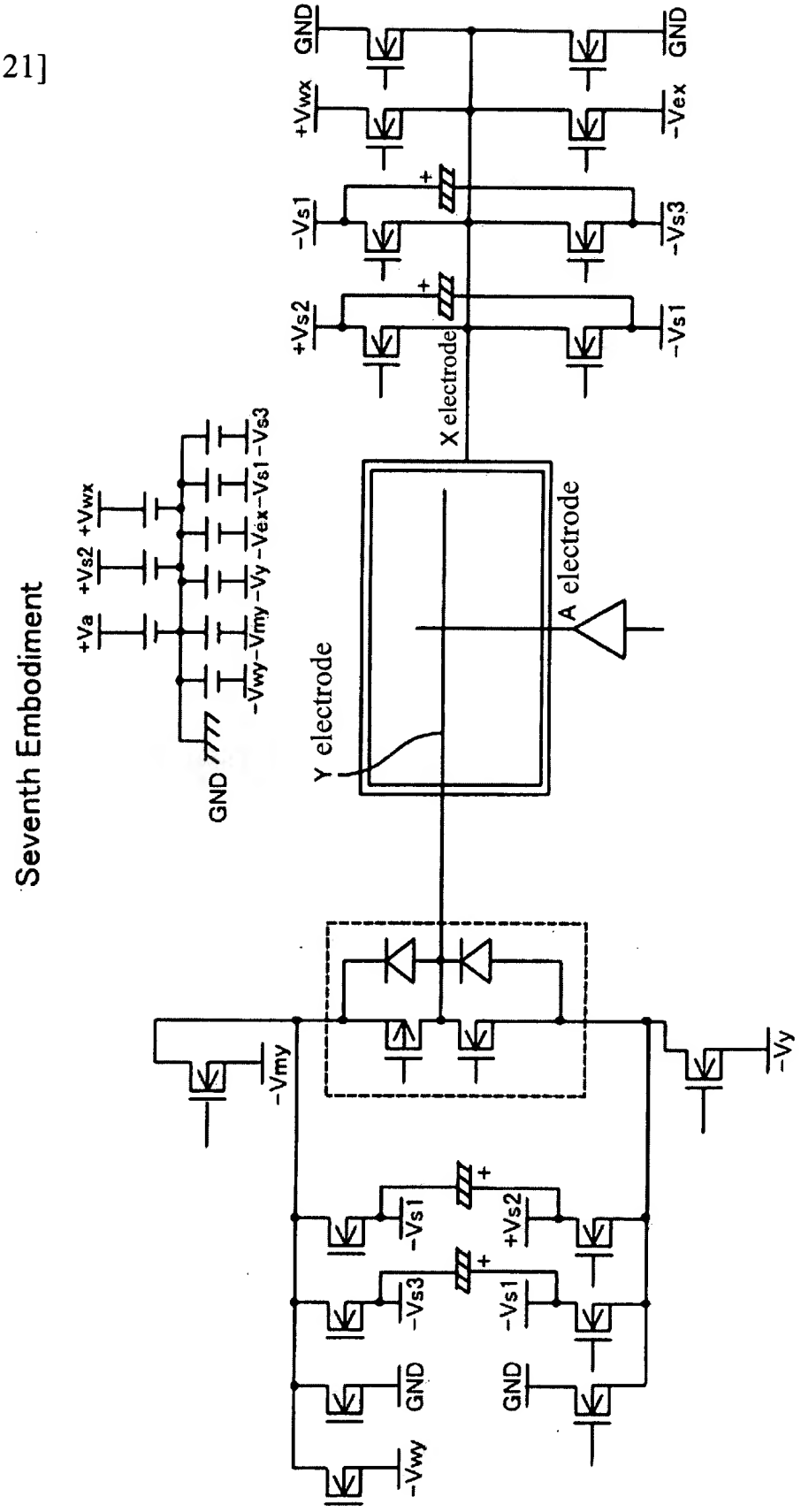

Sixth Embodiment
Q42
+Vwx
Q15
C1
+Va
Q5
Xelectrode
Q6
-Vmy
+Vey
+Vwx
-Vy
+Va
-Vmy
GND
Y electrode
A electrode
Q30
-Vy
Q1
Q2
Q3
-Vmy
+Va
Q4
+Vey
Q14
Q41
30
Control circuit
GND

[FIG.20]

Seventh Embodiment

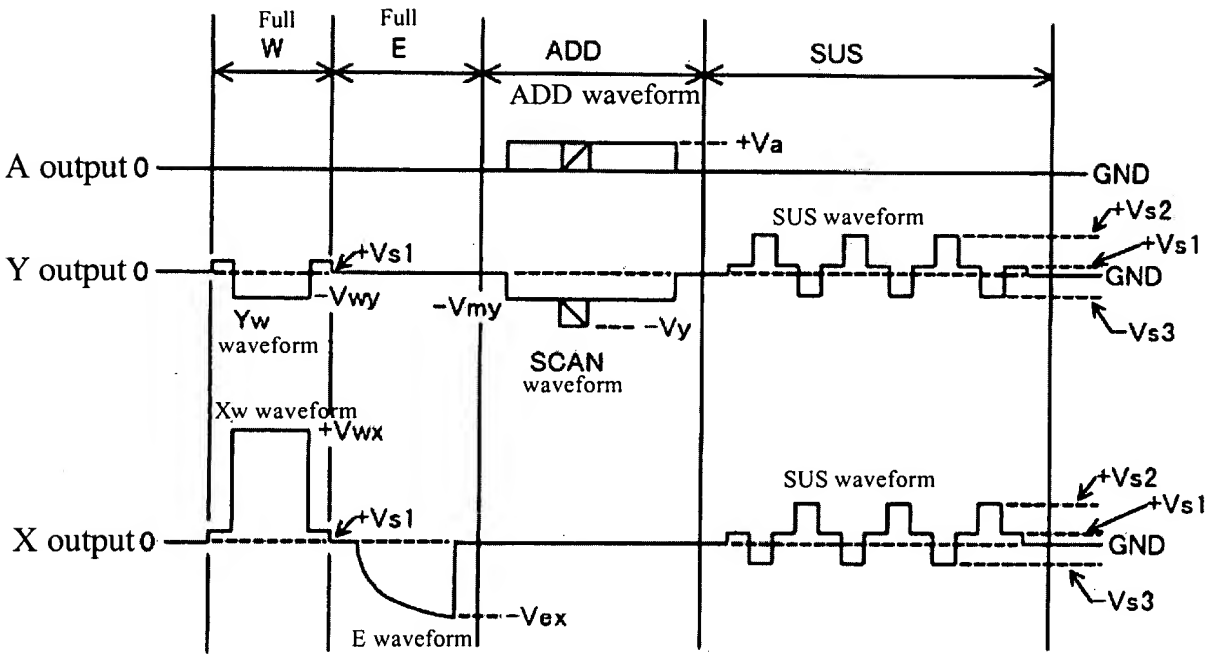


[FIG.21]

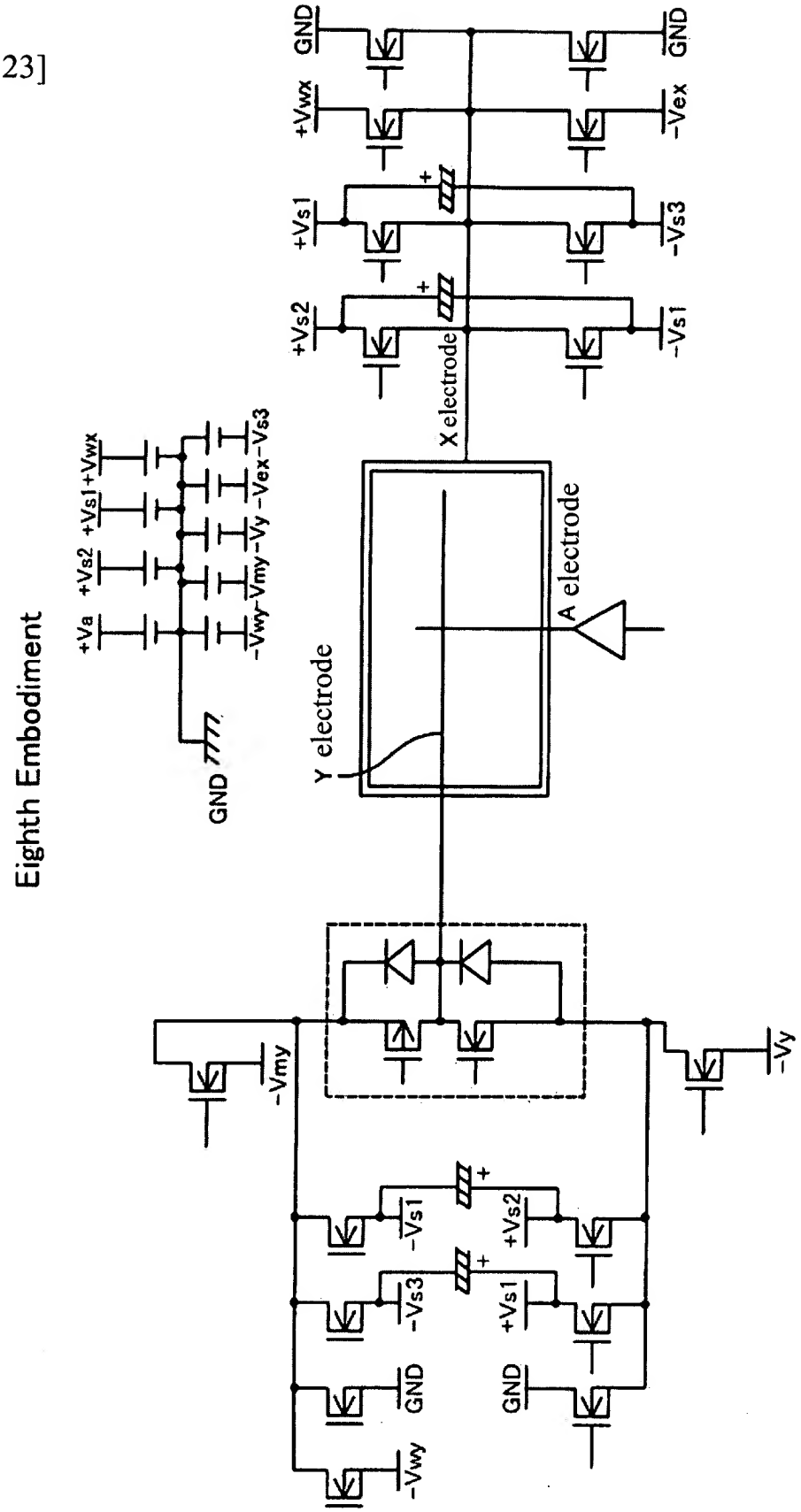

Seventh Embodiment
GND
+Vwx
-Vex
-Vs1
-Vs3
+Vs2
-Vs1
X electrode
A electrode
Y electrode
+Va
+Vs2
+Vwx
-Vwy
-Vmy
-Vy
-Vex
-Vs1
-Vs3
GND
-Vmy
-Vy
-Vs1
+Vs2
-Vs3
-Vs1
GND
GND
-Vwy

[FIG.22]

Eighth Embodiment



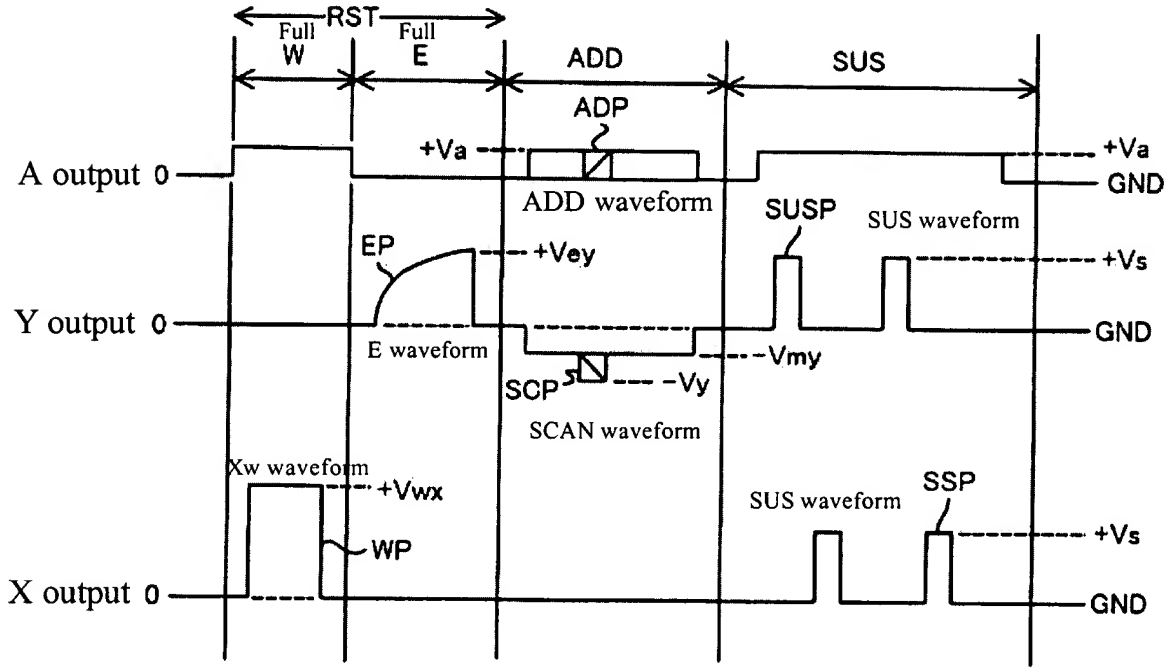
[FIG.23]


Eighth Embodiment
GND
+Vwx
+Vs1
+Vs2
-Vs1
-Vs3
-Vex
X electrode
A electrode
Y electrode
+Va
-Vwy
-Vmy
-Vy
-Vmy
-Vy
-Vwy

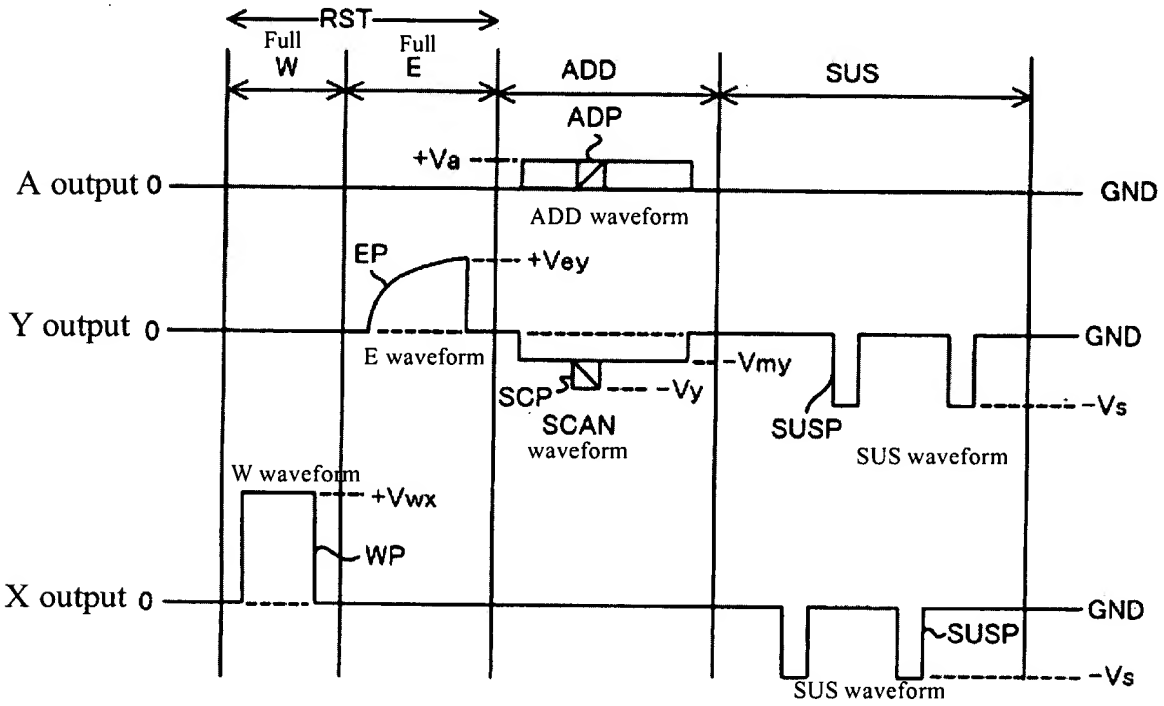
[FIG.24]

Prior Art

(a) Example 1



(b) Example 2



[Document name] Abstract

[Abstract]

[Problem to be solved]

[Solution]

According to the present invention, discharge voltage pulses are applied between a pair of electrodes by driving a first power source having a specific voltage from a state in which the electrodes are maintained at the potential of a reference power source that is different from the potential of the ground power source, and then returning it to the reference power source. As a result, the gas discharge current or capacitance charging and discharging current accompanying the application of the discharge voltage pulses is prevented from flowing to the first power source line. The above-mentioned gas discharge current or capacitance charging and discharging current resulting from the application of the discharge voltage pulses flows to the first power source or the reference power source electrically separated from the ground power source, and does not flow to the ground power source line, so no noise is generated on the first power source.

[Selected drawings] Fig.4